The Heating and Ventilating Magazine

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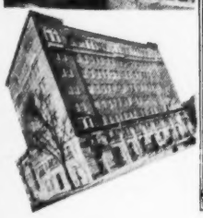


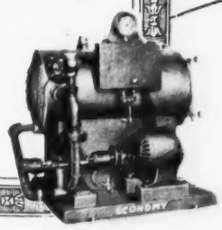
EVIDENCE OF EXCELLENCE

Heating systems in these and numerous other pretentious buildings are operated successfully by Economy Centrifugal Vacuum Pumps.

These pumps are the embodiment of simplicity, accuracy of workmanship and high quality materials.

Dependability—Durability, positive operation are their recommendations.

ECONOMY Products
Condensation Pumps
Boiler Feed Pumps
Sewage Ejectors
Bilge & Sumps
Cellar Drainers
Centrifugal Pumps
House Pumps
Circulating & Oil Pumps
Water Systems



ECONOMY PUMPING MACHINERY CO.

122-124 No. Curtis St. Chicago Illinois.

McKINLEY HIGH SCHOOL,
CANTON, OHIO

Architect—Geo. F. Hammond, Cleveland, Ohio

Engineer—Wm. Kingsbury, Cleveland, Ohio

Heating and Vent. Contractors, Huffman-Wolfe Co., Columbus, Ohio

Selected for the Finest School in Canton

NAMED in honor of Canton's most illustrious citizen, the late President, the McKinley High School is easily the most imposing educational edifice in that section of Ohio. In accordance with the general scheme of the architect, engineer and contractors, to make this high school not only most commendable in appearance but a healthful and comfortable place as well, extreme care was taken in the selection of the ventilating equipment.

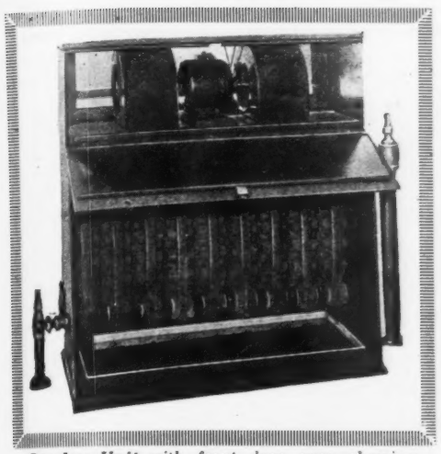
We are justly proud that, after due consideration, Clarage Kalamazoo Multiblade Fans were chosen. Two large Multiblade Fans located in the basement keep the entire building supplied with fresh, pure air, properly warmed in winter and cool in summer.

It has been our policy, from the very first, to manufacture a reliable product and to render a conscientious service in connection with the application of this product. Technical training and years of practical experience have qualified Clarage engineers to cooperate intelligently with the architect and the heating and ventilating engineer. If you will afford the opportunity, we will clearly demonstrate that our claims for both product and service are not exaggerated. Send for our latest catalog today.

CLARAGE FAN COMPANY

New York Chicago Cleveland
Philadelphia Detroit Pittsburgh
Minneapolis Boston St. Louis
Los Angeles Indianapolis
Main Office and Factory, KALAMAZOO, MICH.

CLARAGE — KALAMAZOO Multiblade Fans



Peerless Unit with front door open showing fans and motor. Front panel and baffle removed, showing special Peerless Vento radiation and humidifying pan.

Peerless Performance

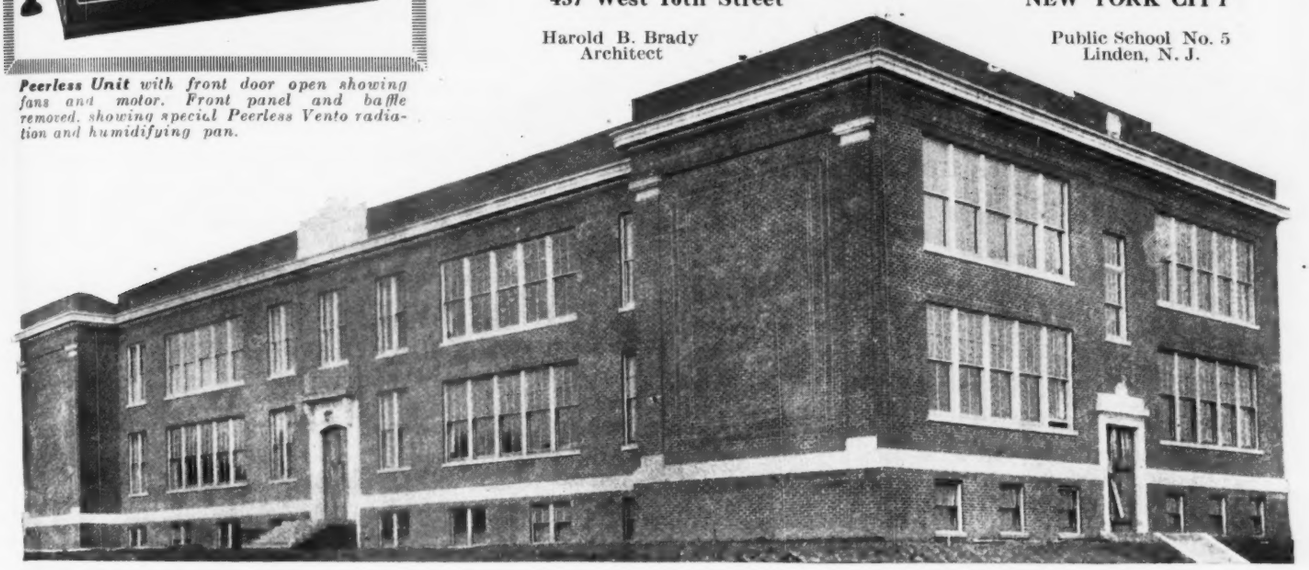
A sturdy Peerless Unit in each room supplying pure, fresh air to the required amount, with perfect distribution and at the right temperature.

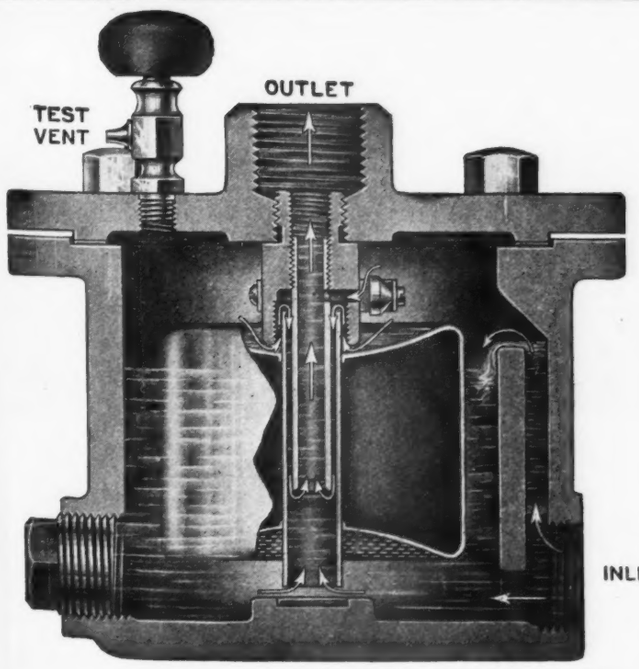
Positive control of room temperature assured by our mixing damper, the best designed for units. Units adaptable to all steam conditions. The ideal system for new and old schools. That's *Peerless* Performance. Send for brochure showing school installations all over the country.

PEERLESS UNIT VENTILATION COMPANY
437 West 16th Street **NEW YORK CITY**

Harold B. Brady
Architect

Public School No. 5
Linden, N. J.





MARSH

DUPLEX WATER SEAL LOW PRESSURE

BLAST TRAP

FOR DIRECT OR INDIRECT COILS OR ANY LOCATION WHERE LARGE QUANTITIES OF WATER ARE TO BE DISCHARGED

Operates automatically either with or without mechanical suction on return line.

No complicated parts to stick or get out of order.

No small openings to clog up with sediment or scale.

Free passage of water—rapid and steady vent of air and passes no steam.

Combined action of flotation for water and all metal thermostatic vent for air together with relief of air through water seal makes the ideal trap for heavy service.

Adjusted and tested at factory and shipped ready for installation, to work automatically from below atmosphere on up to 25 pounds steam pressure.

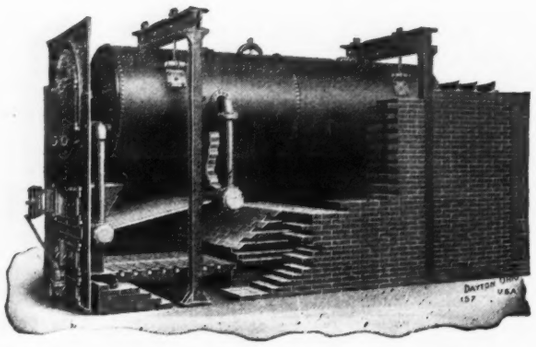
We Invite Correspondence

JAS. P. MARSH & CO., 118-124 South Clinton Street, Chicago

FOUNDED 1865

Manufacturers of Radiator Traps and Specialties—Automatic Air Valves and Vents
Indicating and Recording Gauges

Agents for Great Britain and Ireland: Chatterton & Co., 30 Fetter Lane, E. C. 4, London
Agents for Dominion of Canada: Taylor-Forbes Co., Ltd., Guelph, Ontario



Horizontal Return Tubular Boiler with Smokeless Furnace

BROWNELL

LARGE HEATING UNITS

The Horizontal Return Tubular Boilers are widely used for heating factories, hotels, schools, public and private buildings, where large units are required.

HIGH PRESSURE

Very often for such installations high pressure steam is required to obtain satisfactory results. The type of boiler illustrated here is easily designed for the desired working pressure.

SMOKELESS COMBUSTION

The Down Draft Furnace feature meets the most rigid smoke requirements. It is found to give most pleasing results when used under a Horizontal Tubular Boiler.

EFFICIENT OPERATION

Because of the complete combustion obtained by the use of the Smokeless Furnace, this type of installation gives very efficient results. The Horizontal Tubular Boiler has been a Brownell specialty for 67 years.

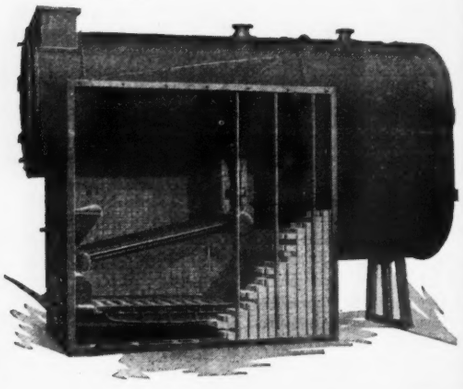
Bulletins B-1 and B-4

THE BROWNELL COMPANY
DAYTON, OHIO, U. S. A.
Established 1855

BOILERS

TITUSVILLE PERFECTION SMOKELESS BOILERS

with their downdraft furnace, brick lined fire box and steel casings are all that the name implies. These features make them the best of all smokeless boilers both in theory as well as actual use.



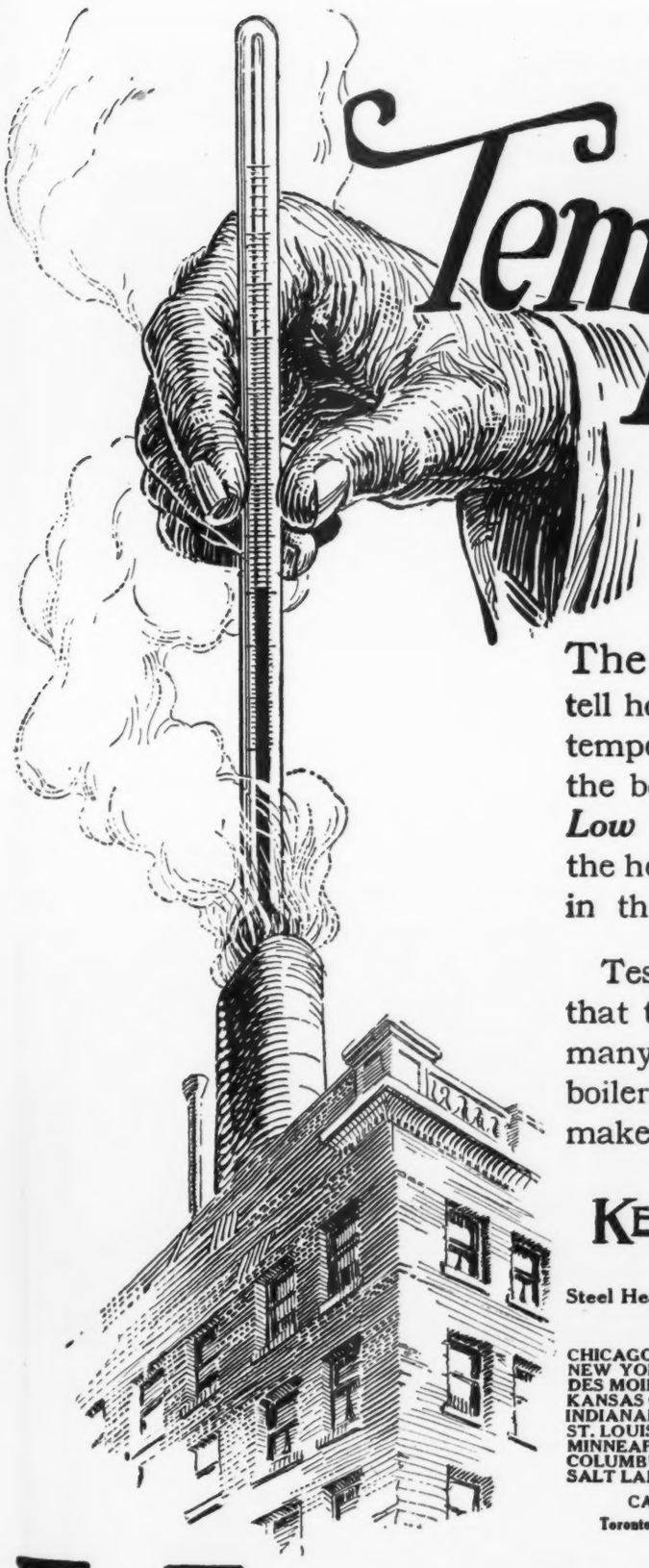
TITUSVILLE PERFECTION BOILERS

SMOKELESS

These boilers are made in sizes 40 to 200 H. P. in working pressures from 15 to 150 pounds A.S.M.E. Code, for power and heating. They are especially adapted to installations where the space is limited.

Our catalogue No. 81 giving full description will be mailed to anyone interested.

THE TITUSVILLE IRON WORKS CO.
TITUSVILLE, PENNA.



The Temperature of the stack gases

The temperatures of the stack gases tell how much heat a boiler is wasting. ***High*** temperatures mean that too much of the heat the boiler makes gets up the stack ***unused.*** ***Low*** temperatures show that practically all the heat generated, is transferred to the water in the boiler and ***used*** for making steam.

Tests of boilers in actual operation show that the gases come from a Kewanee Boiler many degrees cooler than those from other boilers. Kewanee Boilers ***use*** the heat they make. Hence a smaller coal bill.

KEWANEE BOILER COMPANY

KEWANEE, ILLINOIS

Steel Heating Boilers, Radiators, Tanks, Water Heating Garbage Burners

BRANCHES:

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ST. LOUIS	1212 Chemical Bldg.	TOLEDO	1121 Nicholas Bldg.
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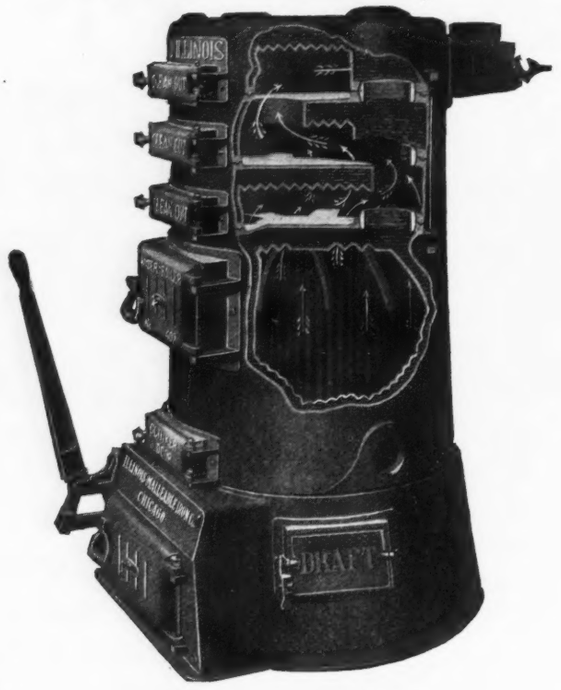
KEWANEE

IMICO HEATING BOILERS

For Water and Steam

Various Sizes



Imico Vacuum Heating System

Write For Catalogue

Manufactured by

ILLINOIS MALLEABLE IRON CO. Chicago, Ill.

"Oil City" Boilers for Heating

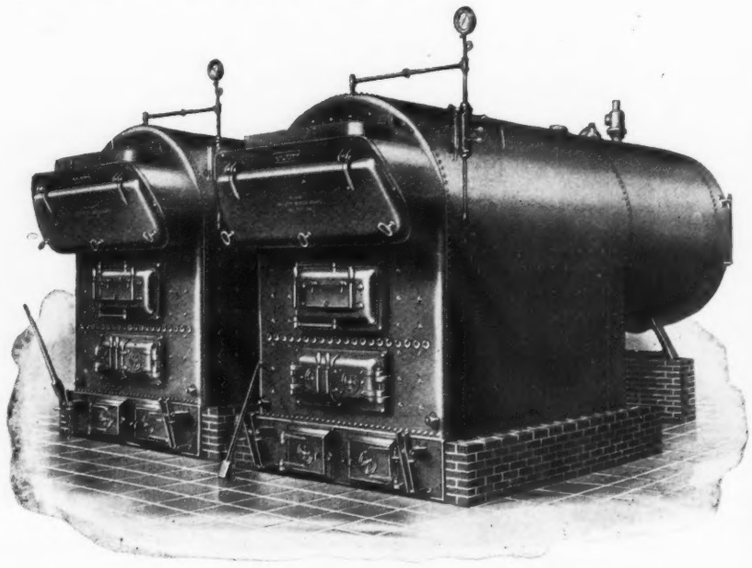
Return Tubular Portable Firebox

Will burn any kind of fuel,—hard or soft coal, oil, gas or lignite. Note use of high firebox, giving ample combustion area to make possible the use of low-grade fuels.

Why "Oil City" Boilers are Ideal for Heating Work:

These boilers are adaptable for Apartments, Churches, Club Houses, Court Houses, Hospitals, Garages, Hotels, Office Buildings, Large Residences, Post Offices, Schools, etc., because they are Safe, Efficient, Dependable, and, being Self Contained, require little attention.

Circular H-5, H-7, H-12, H-13, gives Full Specifications, Ratings and Weights.



Built of Steel, in Accordance with the A. S. M. E. Code

OIL CITY BOILER WORKS, OIL CITY, PA.

BRANCH OFFICES

NEW YORK, 501 Fifth Ave. CHICAGO, No. 1224 Marquette Building PITTSBURGH, House Building

REPRESENTATIVES

CLEVELAND, OHIO PHILADELPHIA, PA. SEATTLE, WASH. BALTIMORE, MD.
SAN FRANCISCO, CAL. ST. PAUL, MINN. DENVER, COL. HOUSTON, TEXAS

Let Your Heating Plant Furnish Your HOT WATER
DURING THE HEATING SEASON
You can have an abundant supply of hot water while heating plant is in operation and SAVE THE COST of gas or other fuel bills. Send for free booklet and give name of plumber also kind of heating used. Excelso Heaters are sold by plumbers and steamfitters
EXCELSO SPECIALTY WORKS
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This Booklet Tells The Story
EXCELSO
No Gas Bills During Heating
HOT WATER without GAS BILLS
DURING THE HEATING SEASON
Eliminate the cost of heating water by gas, electricity or separate fire. Let your heating plant furnish an abundant supply of hot water.
Send for free booklet and give name of plumber, also kind of heating.
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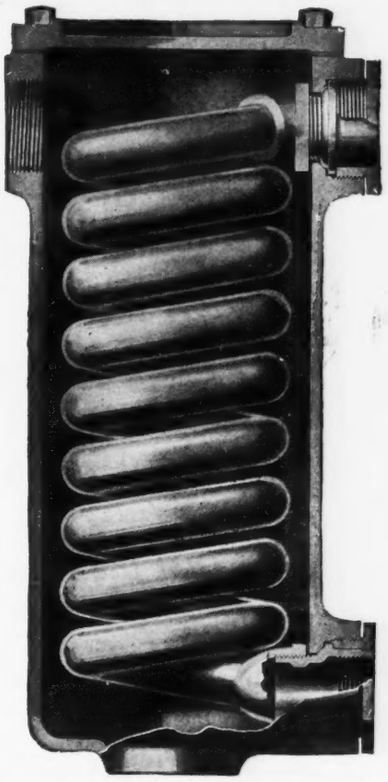
This Booklet Tells The Story
EXCELSO WATER HEATERS
Sold by All Plumbers and Steamfitters
Why Pay Gas Bills For HOT WATER
DURING HEATING SEASON
This Booklet Tells The Story
Let your heating plant furnish an abundant supply of hot water and ELIMINATE THE COST of heating water by gas, electricity or a separate fire. Send for free booklet and give name of plumber, also kind of heating used.
EXCELSO SPECIALTY WORKS, 1 EXCELSO BLDG, BUFFALO
EXCELSO WATER HEATERS
Sold by All Plumbers and Steamfitters



SPECIFY

EXCELSO

WATER HEATERS

which are nationally advertised, ads like the above appearing regularly in the ***Saturday Evening, American Magazine*** and ***Good Housekeeping.***

The Excelso provides a constant supply of hot water with no gas or electricity bills during the heating season. The heating plant, steam or vapor, is the source of heat for the Excelso Method. Heater connects on outside of boiler. Does away with fire-pot coils.

Excelso Water Heaters are sold and endorsed by all the leading boiler Manufacturers,

American Radiator Co.
Richardson & Boynton Co.
Richmond Radiator Co.
Standard Heater Co.
Utica Heater Co.
Burnham Boiler Corp.
Pierce, Butler & Pierce Mfg. Co.
United States Radiator Co.
International Heater Co.
Boynton Furnace Co.
The Wm. H. Page Boiler Co.
Gurney Heater Mfg. Co.
Thatcher Furnace Co.
Abendroth Bros.
Monitor Bi-Loop Radiator Co.

Also by Plumbing and Heating Jobbers everywhere

Write for new booklet—gives full information. Also learn how *you can profit* from this national advertising. Excelso Dealers everywhere.

Excelso Specialty Works, 117 Clinton St., Buffalo, N. Y.

Special New York Sales Representative, John G. Kelly, 137 East 43rd Street
New England Representative, Daniel L. Hanson, 46 Cornhill, Boston, Mass.

INTERNATIONAL
ECONOMY BOILERS

Sectional—Steam

Round—Water

All that the Name Implies

Day in and day out, during the heating season, you will find Economy Boilers doing their work efficiently and economically.

Economy of fuel is made possible thru proper combustion together with a thorough utilization of gases, which gives high evaporative power.

Economy of labor comes through the ease and convenience of operation. Long intervals without attention and simple management appeal to the owner as time and labor savers.

Economical installations are accomplished by the elimination of expensive pipe headers. Dry steam is delivered to the system as the water is separated from the steam within the sections, making a header unnecessary.

Economy of upkeep is assured because the materials and workmanship are first class and the construction eliminates one of the most frequent causes of cracked sections.

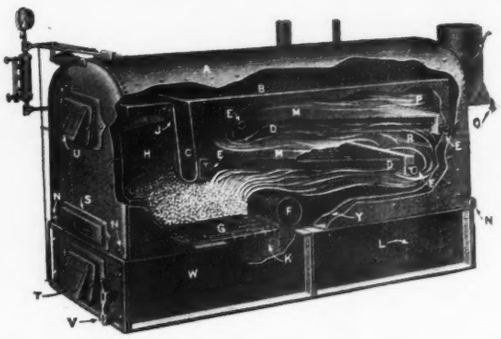
Learn more about Economy Boilers by writing for catalog H-1296

INTERNATIONAL HEATER COMPANY
UTICA, N. Y.

BRANCHES:
New York Chicago Cleveland Nashua, N. H.

INVESTIGATE

The Latest Herbert Magazine Water Tube Smokeless Boiler



These are a few of the Features

(1) No smoke after the fire is thoroughly started. (2) No Flues to clean. (3) Burns Soft Coal Successfully. (4) Carries steam from twelve to fifteen hours with one fire. (5) Has downdraft and direct draft to suit weather conditions. (6) It is all shell surface, which means economy. (7) Can be set in brick, which gives one more return of the hot gases. (8) No Brick Arches or other flimsy devices. (9) Natural draft and the highest economy. (10) Built in steam sizes from 500 square feet to 25,000 square feet

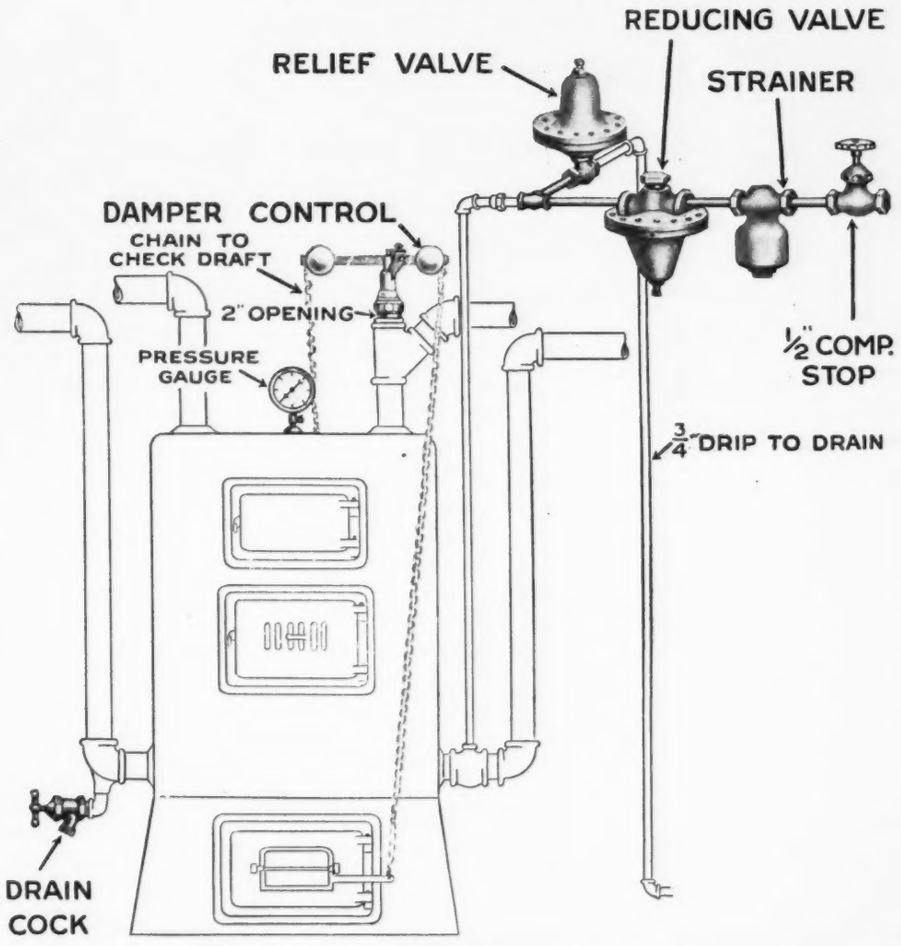
HERBERT

Has combined the downdraft feature with the direct draft and dispensed with the objectionable parts of both.

HERBERT BOILER COMPANY

Root & LaSalle Sts.
Chicago, Illinois

It's Automatic—
—No Expansion Tank



(Patented)

The *MUELLER Automatic System of Hot Water Heat Control* is automatic throughout and thoroughly dependable—no tank of any kind.

Comes assembled — simple and easy to install. Under average conditions takes less than an hour. It is suitable for any size job — sold at a price insuring a fine profit.

Ask for literature — Let us explain the superior points of this unequaled system.

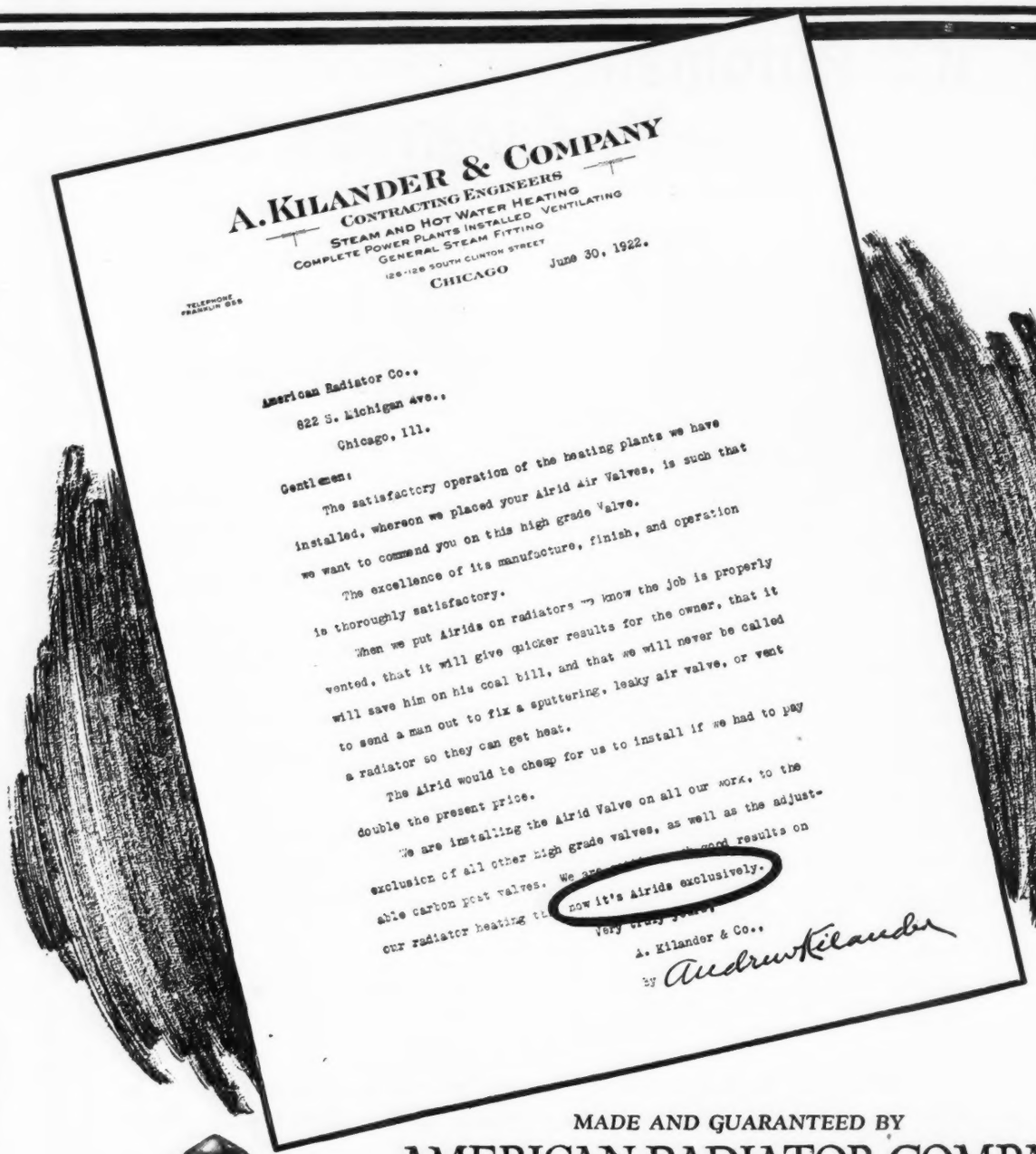
H. MUELLER MANUFACTURING COMPANY, DECATUR, ILL.

New York
145 W. 30th St.

Sarnia, Ont.

San Francisco
635 Mission St.

Now it's AIRIDS exclusively



A. KILANDER & COMPANY
CONTRACTING ENGINEERS
STEAM AND HOT WATER HEATING
COMPLETE POWER PLANTS INSTALLED VENTILATING
GENERAL STEAM FITTING
126-128 SOUTH CLINTON STREET
CHICAGO June 30, 1922.

TELEPHONE FRANKLIN 688

American Radiator Co.,
822 S. Michigan Ave.,
Chicago, Ill.

Gentlemen:

The satisfactory operation of the heating plants we have installed, whereon we placed your Airid Air Valves, is such that we want to commend you on this high grade Valve.

The excellence of its manufacture, finish, and operation is thoroughly satisfactory.

When we put Airids on radiators we know the job is properly vented, that it will give quicker results for the owner, that it will save him on his coal bill, and that we will never be called to send a man out to fix a sputtering, leaky air valve, or vent a radiator so they can get heat.

The Airid would be cheap for us to install if we had to pay double the present price.

We are installing the Airid Valve on all our work, to the exclusion of all other high grade valves, as well as the adjustable carbon post valves. We are ... good results on our radiator heating th... now it's Airids exclusively.

Very truly yours,
A. Kilander & Co.,
By Andrew Kilander

MADE AND GUARANTEED BY
AMERICAN RADIATOR COMPANY
IDEAL Boilers and AMERICAN Radiators for every heating need
1807 Elmwood Avenue Dept. S.106 Buffalo, N.Y.

WHEN STEAM rushes into a radiator it pushes air ahead of it. Airid Air-Valves instantly let this clogging air out so that steam can come into every loop of the radiator—without forcing the fire.

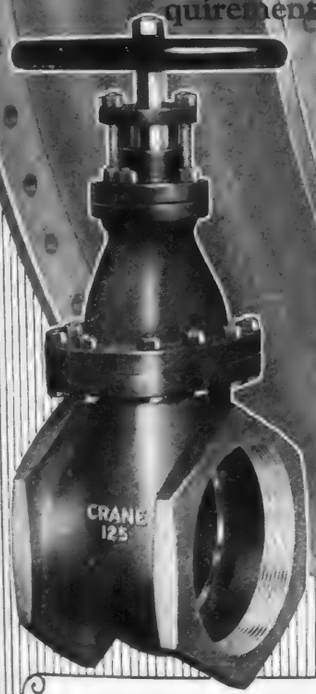
AIRID
Air Valve
Rids the radiator of cold air

CRANE SERVICE

is equally available for the heating, ventilating, refrigeration, power-plant and sanitation requirements of all buildings from the small home to the large industrial plant.

From the smallest auxiliary fitting to the largest valve or steam specialty, we can supply in brass, iron, ferrosteel, cast steel and forged steel in all pressures and for all purposes.

In more than 100 cities there are Crane branches, sales offices and exhibit rooms, thoroughly equipped to aid in the selection of power-plant and sanitation equipment for every service requirement.

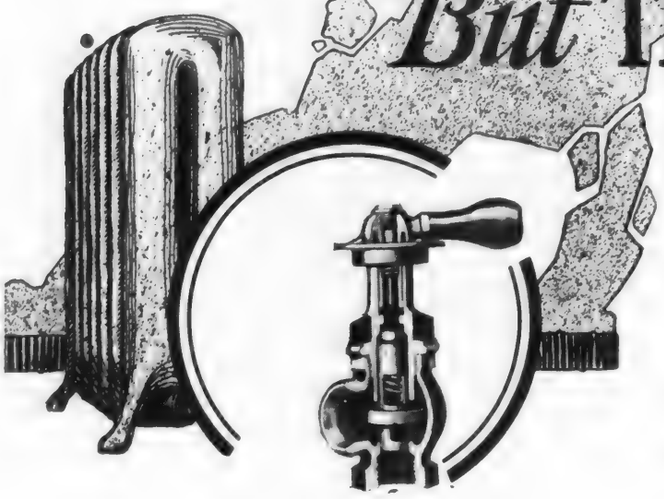


Branches and sales offices in more than 100 cities

1855 — CRANE CO. — 1922
836 South Michigan Avenue, Chicago
Works—Chicago and Bridgeport

National Exhibit Rooms
Chicago, New York
Atlantic City

Not Their Price *But* Their Performance



Lavigne Packless Steam Valves have never been sold on a basis of price. They are sold, and bought, on their record of performance—never failing in service.

They are made not just to be "good enough" but to be more durable than necessary: leakless, quick opening, easy working and accurate. The price is of course higher than less carefully made valves but they are worth it. They are economical in the long run for they eliminate later replacements and the repairs necessary when ordinary valves are used.

Lavigne Packless Steam Radiator Valves are made in Angle, Globe, right or left-hand corner styles; furnished with Round Wheel or Plain Lever Handle, Graduated Dial with Lever Handle or Round Wheel, Extension Type with Lever Handle or Round Wheel, also Lock Shield, either Plain or Graduated. The complete range of styles and sizes satisfies every requirement for Vapor, Vacuum, Central Station or Low Pressure Steam Heating Systems.

LAVIGNE

PACKLESS STEAM RADIATOR VALVES

"BUILT RIGHT———TO STAY TIGHT"

COMMONWEALTH BRASS CORPORATION

DETROIT **MICHIGAN**

NEW YORK 48 E. 41st Street

CHICAGO 332 So. Michigan Avenue

SAN FRANCISCO 68 Post Street

Announcing the ADSCO GRADUATED PACKLESS Radiator Valve

This valve is a great refinement of the well-known Adsco Graduated Radiator Valve at no advance in price.

It has closer graduation, especially on small openings. It is therefore more positive in control. It is made entirely in our own plant and is thoroughly inspected and guaranteed. The black dial with nickel lettering, and general appearance are more attractive. Because of design and careful construction safety against corrosion and sediment is assured. It can be used with any steam or vapor system with better results than any other make of radiator valve, graduated or otherwise.

It has been especially developed for use in the Adsco System of Atmospheric Steam Heating in conjunction with the Adsco Damper Regulator, Safety Valve, Mercury Gauge and Union Elbow; with any type of boiler or steam supply, and any suitable type of radiation. This principle of heating needs no traps, vacuum pumps or other complicated devices; their cost is saved.

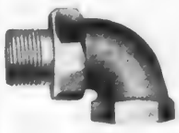
The Adsco Graduated Packless Radiator Valve is furnished to heating contractors at a uniform price. Unlike many makes of competitive vapor specialties, it is sold on a merchandise basis and not thru lumping the price in connection with engineering specifications.

When desired, our engineering service will be furnished to architects or contractors at a moderate fee independent of unit prices for the specialties required.

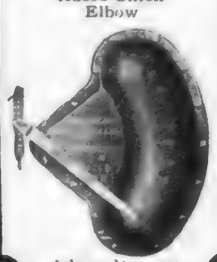
Write for Bulletin No. 158-H covering Adsco Heating for individual buildings, and including the Adsco Specialties; Bulletin No. 20-H covers Adsco Community Heating of a group of buildings from Central Station Heating Plant. Architects, engineers and heating contractors should also ask for Bulletin No. 159-H.

Adsco Mercury Gauge

Adsco Safety Valve



Adsco Union Elbow



Adsco Damper Regulator

Residence of J. M. G. Brown, Morgantown, W. Va. Adsco Heating

Higley Bldg., Cedar Rapids, Ia. Adsco Heating; Steam from Central Station

AMERICAN DISTRICT STEAM COMPANY

GENERAL OFFICES AND WORKS

NORTH TONAWANDA, N.Y.

OFFICES:

Chicago St. Paul New York Pittsburgh Seattle

ADSCO HEATING

HEAT INSURANCE

MANY of the troubles incident to steam heating systems are directly traceable to the valves. Worn out packing, leaky gaskets—any one of the half a dozen things may cause trouble.

Dole Packless Valves never require repair. Many of them, in service sixteen years or more, show no signs of wear or deterioration. The Dole Packless disc ***never wears out.***

The ball-bearing action is an exclusive feature of Dole Valves. Even after long periods of idleness, Dole Packless Valves turn as easily as when installed. And they're good-looking too. The brilliant nickel finish won't tarnish or rust.

The Dole Modulating Valve, a further development of the Dole Packless Valve, affords instantaneous regulation of temperature. Indicator points to exact degree of heat obtained. Same ball-bearing feature. No packing to wear out and cause leaks. Furnished in lever handle or the new knob handle, as illustrated above.

Send for free illustrated booklet "A".

DOLE VALVE CO.

1931 Carroll Ave., CHICAGO, ILL.

Announcing

the greatest improvement ever made in hot-water radiator valves

NO matter how carefully a hot-water job is installed, there is always friction. But the new Genuine Detroit Hot-Water Radiator Valve eliminates 90 per cent of friction troubles by insuring perfect water circulation through the valve into the radiator. Here are its four distinctive advantages:

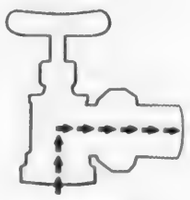
1 The curved inlet plate has less than one-tenth the contact surface of the old type valve. And the scraping edge keeps the contact surface clean so corrosion can't stick the valve.

2 The curved inlet plate makes the water *curve* into the radiator, instead of bumping into the old square cornered turn.

3 The handle is of new design—non-breakable and non-heat-conducting. It is handsome in appearance, with a permanent, black, hard-rubber finish.

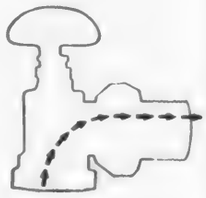
4 An indicator attached to the handle travels between two stops, showing at a glance whether the valve is on, off, or in an intermediate position.

Best of all, this new valve *costs not one cent more than the ordinary type.* Your jobber can supply you with a "Genuine Detroit" radiator valve for every heating need.



The old way

In the old type valve, water bumps into a square inlet, causing eddies and back swirls.



The Genuine Detroit Way

The water strikes the curved inlet plate and *curves* naturally into the radiator.

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Hot Water Radiator Valves

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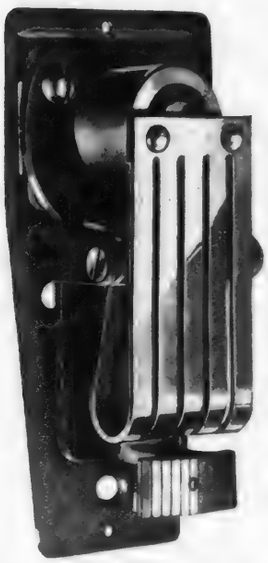

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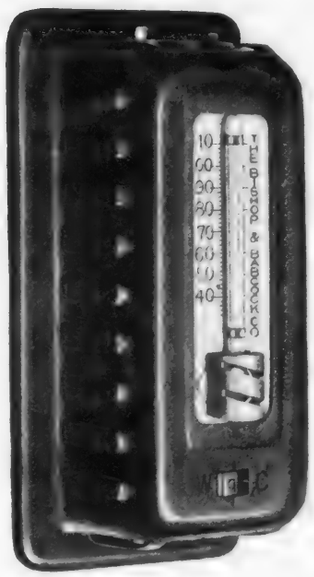

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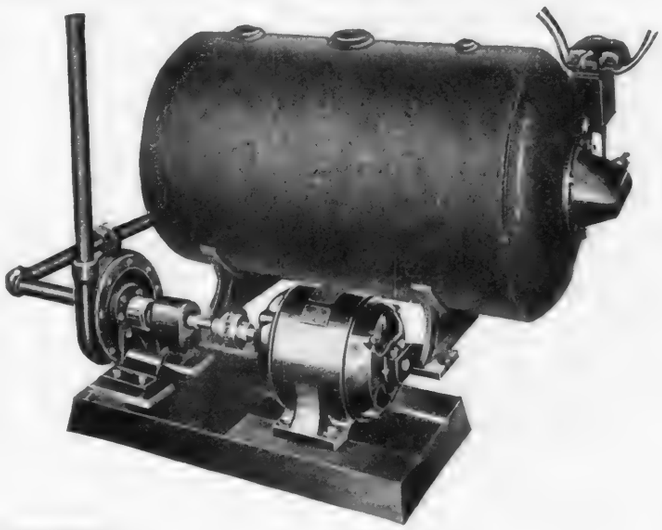

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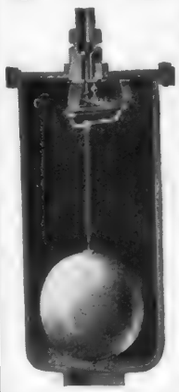

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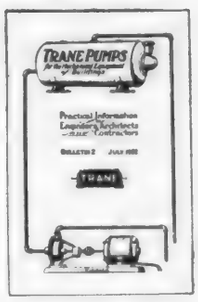

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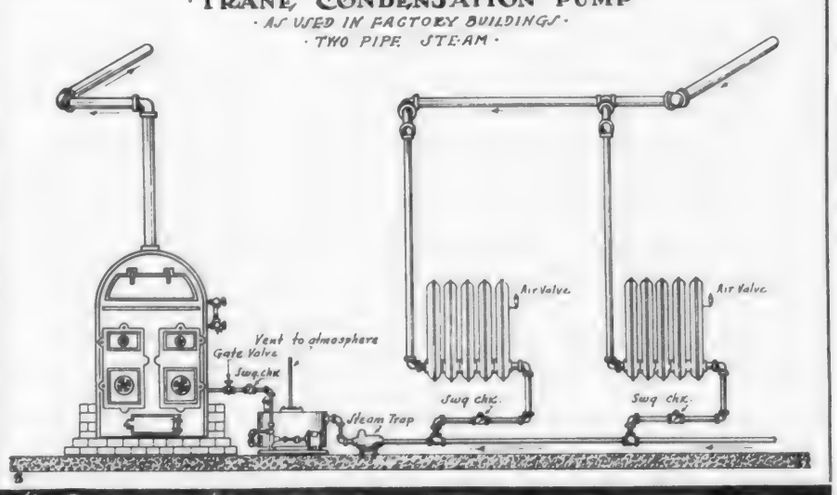

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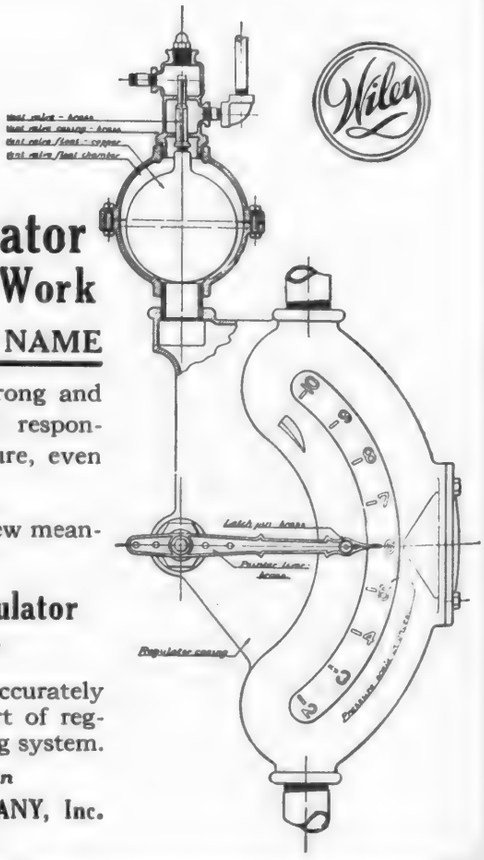

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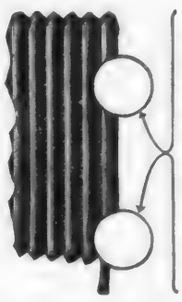

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RADIATOR TRAP

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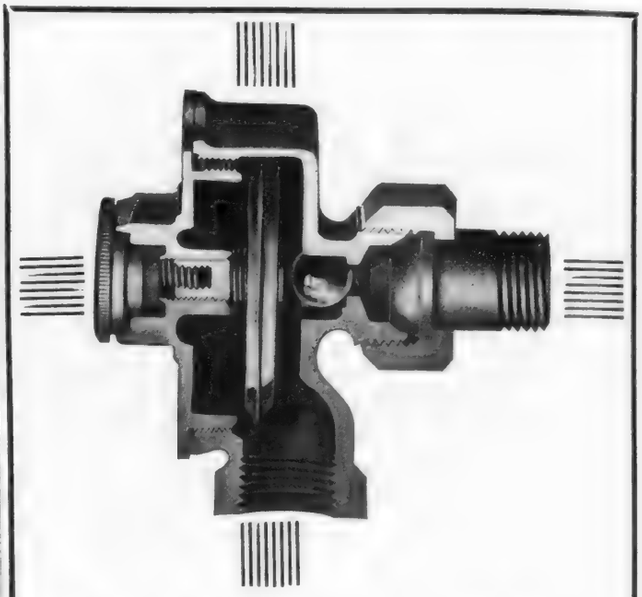

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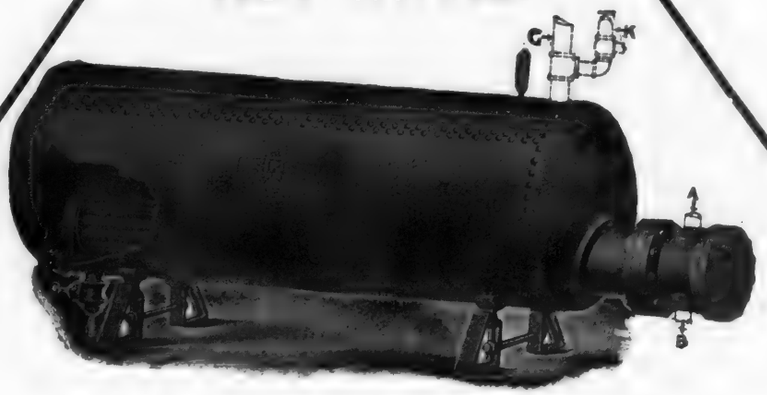

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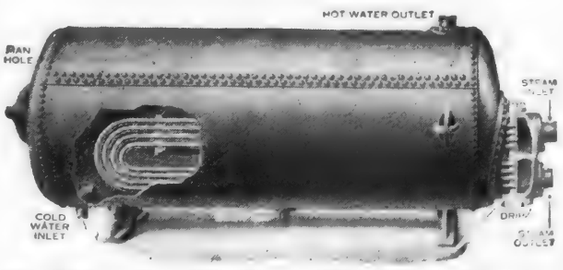

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Then why should you ventilate unoccupied rooms?

It is true that you cannot so easily see the steam that is being wasted for ventilating these unoccupied rooms, but nevertheless you are paying for this waste.

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That is just what I have been leading up. You should install Buckeye Heatovents in your new building, then every room will have its own individual ventilating unit, ready to serve you at any time.

Each one starts to work by pressing a button—the same kind of a button that operates your lights — and it stops the same way. Nothing could be simpler.

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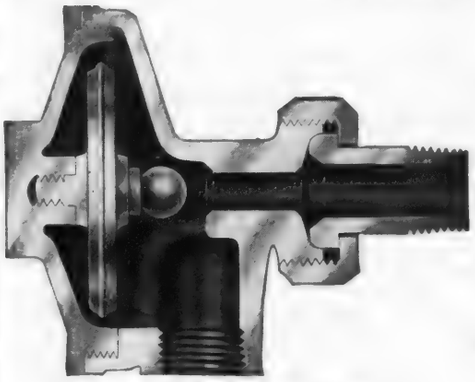

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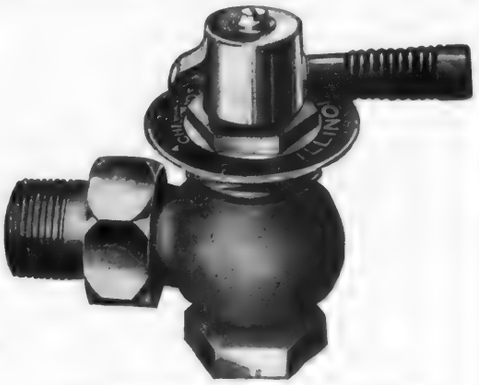

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All working parts accurately machined.
Easiest operating valve on market.

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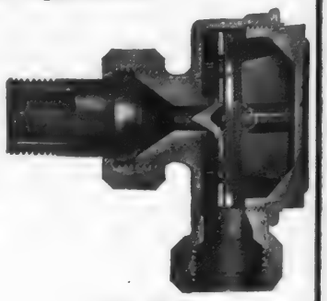

No. 28 Trap

McALEAR MFG. CO.
CHICAGO

The Heating and Ventilating Magazine

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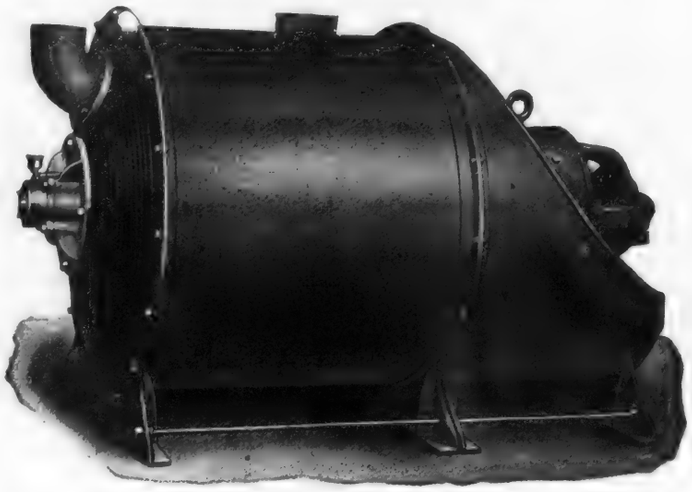
Send for list of references of school installations and complete data regarding the Spencer equipment.

Spencer Turbine

Cleaning Systems



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The Heating and Ventilating Magazine

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AUGUST, 1922

MEASURING THE FLOW OF HEAT IN BUILDINGS BY MEANS OF RESISTANCE WIRES

By F. E. GIESECKE
Head, Engineering Research Division, University of Texas.

SINCE the walls, floors, roofs, and other structural elements of buildings are not homogeneous throughout their extent, the thermal resistance of those elements varies from point to point, and in order to determine its average value it is necessary to use either a large number of thermo couples or a resistance wire of considerable length.

A year ago the Lone Star Ice Company, of Austin, Texas, began the erection of a cold storage building, shown in Fig. 1. This building contains a room about 40x50x24 ft. which is to be used for the storage of ice; the inside temperature will be about 20° F., and the outside temperature about 90° F.

It seemed to the writer that this room would afford an exceptional opportunity for the study of the flow of heat into buildings. The owners kindly permitted the investigation and preliminary studies were made to determine the best method of measuring the flow of heat.

FIG. 1—COLD STORAGE BUILDING OF THE LONE STAR ICE COMPANY, AUSTIN TEXAS.

In this preliminary work the writer had the cordial cooperation of Drs. J. M. Kuehne and L. S. Brown of the Department of Physics, and of Profs. J. M. Bryant and J. W. Ramsey of the Department of Electrical Engineering, and he is deeply indebted to those gentlemen, particularly to Dr. L. S. Brown, who devoted much time to this investigation.

ADOPTION OF THE RESISTANCE WIRE METHOD.

The method finally adopted was the use of 100 ft. of No. 20 rubber-covered fixture wire in the area in which the temperature was to be determined. Repeated trials proved that by this method the temperature could be determined accurately within 1° F.

To eliminate the effect of that part of the wire which was not within the area in which the temperature was to be determined and which was, therefore, generally at a different temperature, two wires, differing from each other in length by 100 ft. were used in every case. The two wires were placed so that both wires extended well into the area in which the temperature was to be determined, and so that the ends of the two wires were under like conditions regarding temperature influences.

The difference between the electrical resistances of the two wires at any one time was therefore the resistance of 100 ft. of wire at the desired temperature. By calibrating the wire the resistance could be easily translated into temperatures.

WIRE FOUND TO BE UNIFORM IN ITS ELECTRICAL RESISTANCE.

It was first thought necessary to calibrate each wire separately, but it was found that the wire was so uniform in its electrical resistance that the same calibration curve could be used for all wires tested. The calibration curve for 100 ft. of No. 20 fixture wire is shown in Fig. 2.

LOCATING THE RESISTANCE WIRES.

As the construction of the building progressed, resistance wires were placed in the floor, walls, ceiling, and roof of the

building. The terminals of the wires running into the ceiling, roof, and south wall are shown in Fig. 3. The construction of the ceiling and roof is shown in Fig. 4.

The roof consists of ⅞-in. ship-lap, supported by 2x6 in. rafters and covered with a four-ply Phoenix composition roof manufactured by Johns-Manville, Inc.

The ceiling consists of a layer of yellow pine boards having an average thickness of 2.02 in., not fitted together but separated slightly so that the area of the air spaces is about 0.0035 of the total ceiling area; and of two layers of cork board,

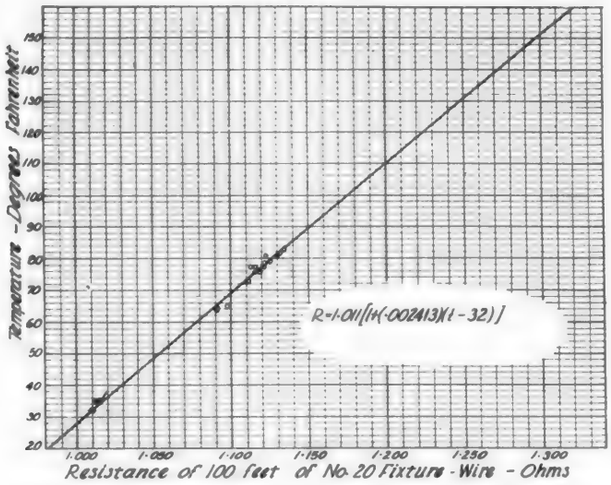


FIG. 2—CALIBRATION CURVE FOR ELECTRICAL RESISTANCE OF WIRE.

the upper layer being 2 in. thick and the lower layer 3 in. and having a ¼-in. mastic finish.

The roof and ceiling are supported by combination wood and iron trusses; the average distance from ceiling to roof is about 5½ ft. The space between ceiling and roof is confined on all sides and since the ceiling is cooler than the roof there is no apparent cause for circulation of the inclosed air, and it would seem that this volume of air should be at rest and should have a fair thermal resistance.

To determine the flow of air through the roof and ceiling six resistance wires were placed as shown in Fig. 4. Wire No. 8 was attached to the under side of the lower cork board and gives the temperature of the air in the upper part of the room. Wire No. 9 was placed between the two layers of cork board. Wire No. 10 was placed between the upper cork board and the wooden ceiling. Wire No. 11 was placed on the wooden ceiling. Wire No. 12 was attached to the under side of the rafters. Wire No. 13 was placed on the composition roof and covered with one layer of roofing felt.

WHAT THE TEMPERATURE READINGS SHOWED.

On May 16, 1922, temperature readings were taken at regular intervals from 8:45 A. M. until 5:45 P. M.

FIG. 3—TERMINALS OF WIRES RUNNING INTO CEILING, ROOF AND SOUTH WALL OF COLD STORAGE BUILDING.

The results of these readings are shown in Fig. 5.

A casual inspection of this diagram shows:

First: That the temperature of the room was not increased by the higher temperature of the roof; the explanation of this is as follows: At the beginning of the test the air in the room was warmer than the lower layer of cork board; it was about 4 P. M. before the temperature of the lower cork board had reached that of the air of the room and hence the cork board could not transmit heat to the air until after 4 P. M.; the test was ended at 5:45 P. M.

Second: The thermal resistance of the 2-in. pine ceiling was not very different from that of the 2-in. cork board underneath it, because the distances between lines 11 and 10 and between lines 10 and 9 do not differ materially from each other.

Third: The thermal resistance of the 5½-ft. layer of air is very much less than that of the 2-in. wooden ceiling, because the distance between lines 12 and 11 is only about half the distance between lines 11 and 10, although more heat was passing through the air space than through the wooden ceiling.

Fourth: The temperature shown by Wire No. 13 is only the temperature of the copper wire and of the uppermost portion of the composition roof and not that of the upper ship-lap surface, because, if it were, the thermal resistance of the light roof construction would have to be very much higher than it can possibly be.

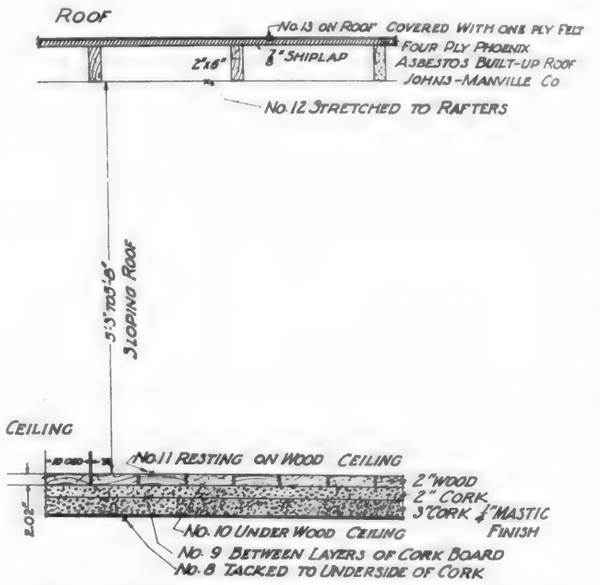


FIG. 4—CONSTRUCTION OF CEILING AND ROOF OF COLD STORAGE BUILDING.

Fifth: A correct determination of the thermal resistance of the roof can only be made when the roof is protected from the rays of the sun.

FLOW OF HEAT NOT UNIFORM WHEN SUN IS SHINING.

In making a more careful study of Fig. 5 it should be remembered that the larger portion of the heat which is radiated to the building by the sun is either reflected by the surface of the roof, or re-radiated by that surface or carried off by currents of air passing over the roof, and that the smaller remaining portion is absorbed by the roof, the roof-trusses, the inclosed air, and the ceiling, and that there is, consequently, not a uniform flow of heat through the entire structure.

The quantity of heat flowing, for example, through the wooden ceiling is less (during the warming-up period) than that flowing through the air spaces above the wooden ceiling and more than that flowing through the cork board below the wooden ceiling.

CONDUCTION FACTORS CLOSE TO FIGURES USUALLY ASSUMED.

Using the temperatures shown in Fig. 5 and assuming the specific heats of air, wood, and cork board to be, respectively,

0.242, 0.467, 0.485, and assuming, further, that the quantity of heat flowing through the 2-in. wooden ceiling is equal to the total quantity of heat absorbed by the cork board, plus one-half that absorbed by the wooden ceiling itself, it appears that,

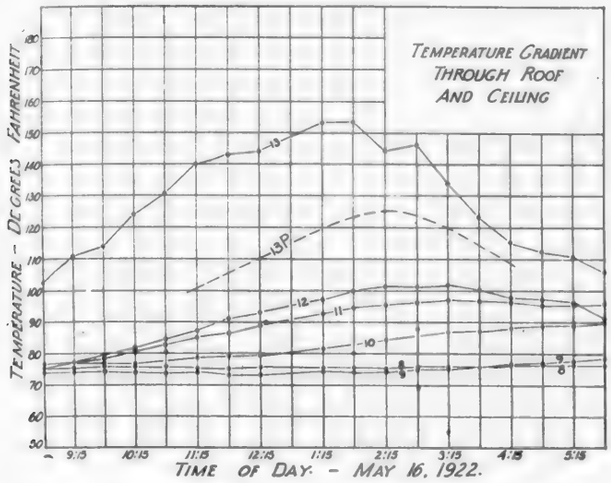


FIG. 5—RESULTS OF TEMPERATURE READINGS.

for the five-hour period beginning at 11:30 A. M., the conduction-factor for the wooden ceiling is 0.442; this agrees very well with that usually assumed for yellow pine, across the grain, and indicates that the temperatures shown in Fig. 5 are quite accurate.

A similar calculation for the air space shows that its conduction factor is 1.67. Consequently, the thermal resistance of this particular layer of air is only equal to that of a layer of wood ½-in. thick.

A similar calculation for the roof, assuming its conduction factor to be 0.5, shows that the temperature of the upper roof surface is given by the dotted line, 13P, instead of by the full line, 13.

The differences in the temperatures shown by the lines 13P and 13 must be the excess temperatures in the uppermost layer of the roof due to the heat which does not flow into the building but is re-radiated from the upper surface, or carried off by air currents.

The total heat reaching the earth from the sun is about 430 B. T. U. per hour per square foot of surface normal to the sun's rays. Since about one-third of this heat is absorbed by the earths atmosphere, and since the average angle between the sun's rays and a normal to the roof, during the five-hour period under consideration, was about cosine $-^{1}$ 90, the average quantity of heat reaching the roof from the sun was, approximately, 258 B. T. U. per hour per square foot. The average quantity absorbed by the building, as calculated from Fig. 5, was 13 B. T. U., or only about 5% of the total heat radiated to the roof by the sun.

Additional tests will be made later in the summer, after the building has been put into service, and the results will be reported as promptly as practicable. The principal object of the present communication is to call attention to the method of determining the transmission of heat in buildings on a large scale by means of resistance wires, in order that others may avail themselves of this method as early as possible.

RECENT PROGRESS OF ENGLISH INVESTIGATORS IN DETERMINING THE RELATION OF ATMOSPHERIC CONDITIONS TO FATIGUE

What the Katathermometer Has Done in Furnishing Data for the Relief of Workers in Oppressive Atmospheres

WHILE American heating and ventilating engineers are aware, in a general way, of the research work that has been done in recent years by English investigators, they will find an interesting summary of this work in a report prepared at the instance of the Transvaal Chamber of Mines by A. J. Orenstein and H. J. Ireland, covering experimental observations upon the relation between atmospheric conditions and the production of fatigue in mine laborers. This report is given in full in the *Journal of Industrial Hygiene*, published by Harvard Medical School.

The reference to the English investigations includes the experiments made by Dr. Leonard Hill, with several students shut in an air-tight chamber of about 3 cubic meters' capacity, which was provided with a large observation window, with electric fans for putting the air in motion, and with means of varying the temperature and humidity of the air. On one occasion the students were confined there till the carbon dioxide content had reached from 3% to 4%, and the oxygen content had fallen from the normal (about 20%) to 16% or 17%, the air failing to support the combustion of matches which the students struck in vain attempts to light cigarettes. The wet-bulb had risen to about 83° F., and the dry-bulb was slightly higher. The discomfort of the students was considerable, their faces flushed, their pulse rate high, and their skin and clothes moist with sweat. *The starting of the fans gave immediate relief* and lowered the average pulse rate from 97 to 79 per minute, though no fresh air from outside was admitted, the fans merely setting in motion the air in the chamber. When the fans were stopped, the students begged to have them started again. *Breathing fresh air from outside through tubes gave no appreciable relief, and persons outside breathing the vitiated air of the chamber experienced no discomfort.* The sudden introduction, from a bag, of carbon dioxide up to 2% was not discerned by the inmates of the chamber.

SUPPLYING EXHALED AIR TO GUINEA PIGS.

In another class of experiments, guinea-pigs were confined for several weeks in a box through which the exhaled air of rats was passed. They were afterwards inoculated with blood serum from the rats but showed no signs of anaphylactic shock, thus demonstrating that breathing the exhaled air of rats had not sensitized them to rat serum. The guinea-pigs, which were again inoculated after the lapse of another three weeks or so, rolled over and died, showing that the first inoculation had sensitized them. Dr. Hill rightly reasons from this that there cannot be any toxins of a protein nature in exhaled air.

INTRODUCTION OF THE KATATHERMOMETER

After the introduction of the katathermometer to measure the cooling power of the air, many interesting experiments were carried out on the respiratory metabolism, or the interchange of oxygen and carbon dioxide, in atmospheres of different cooling power, and under varying conditions of rest and exercise. The subjects of the tests breathed through the mouth into light

bags arranged with valves, clips being fastened over the nostrils to prevent nasal breathing. The air in the bags was afterwards measured by a gas-meter and analyzed for oxygen and carbon dioxide.

RESULTS OF THE HILL RESEARCHES.

The results of Dr. Hill's researches may be summarized as follows:

1. That the quality of "freshness" of air is due to its cooling power on the body, and that, on the contrary, oppressiveness of ordinary atmospheres is due, not to deficiency of oxygen or excess of carbon dioxide and organic toxins, but to "heat stagnation."

2. Cooling power depends on temperature, humidity, and motion of the air, and is increased by low temperature, low humidity and high velocity of motion.

3. That carbon dioxide content up to 1%, or even higher, produces no deleterious effects or stresses on the human system, the only effects being slightly greater ventilation of the lungs such as would take place with moderate increase of exercise.

4. That there is no evidence of the presence of organic toxins in exhaled air.

5. That cooling power in the air—unless carried to extreme—has a beneficial effect upon health generally. It promotes the metabolism of the system, assists elimination of toxins and waste products, and increases immunity to infectious and other diseases.

In considering the effect of carbon dioxide, it is pointed out that the alveolar air, or air in the lung sacs, at ordinary pressures contains from 5 to 6% of carbon dioxide, at about which value it is kept involuntarily by the nerves controlling respiration; when the carbon dioxide tends to exceed this value, greater ventilation of the lungs is induced.

The only result of breathing 0.5% of carbon dioxide is a slight and unnoticeable increase in the ventilation of the lungs. Two per cent. carbon dioxide increases pulmonary ventilation 50%; 3%, about 100%; and 5%, about 300%. Normally we never empty the lungs, and the residual air and that in the respiratory passages, which contains over 3% carbon dioxide, is continually rebreathed. Workers in breweries and aërated water works, where the carbon dioxide content may be from 1.5 to 2.5%, suffer no deleterious effects. In submarines, the crew can tolerate carbon dioxide in the atmosphere up to 3%.

RELATION OF FATIGUE TO MUSCULAR ACTIVITY.

In dealing with fatigue it was found that muscular activity was accomplished by the oxidation of glycogen. This, it is explained, is a chemical process producing heat, a process continually going on to a greater or lesser degree while life lasts. This heat production varies with the degree of muscular activity, and is least when the body is recumbent, relaxed and asleep. This heat-producing activity when the body is resting, Dr. Hill calls the "basal or minimal metabolism," and, as will be seen later, its amount is an important factor in a man's capability to perform work in a hot atmosphere. Heat production is considerably increased when external work is done.

The basal metabolism of the average man corresponds to a heat loss of about 1 millicalorie per square centimeter of body surface per second; work may bring it up to 3 millicalories.

IMPORTANCE OF KNOWING COOLING POWER OF SURROUNDING AIR.

In order that the body may dispose of its heat without strain, the cooling power of the surrounding air should be adequate. Dr. Leonard Hill has recommended the following cooling powers for persons doing different classes of work, the units being in millicalories per square centimeter per second:

1—For sedentary workers, 6 by dry "kata," 18 by wet.

2—For light manual work, 8 and 25.

3—For heavy manual work, 10 and 30.

These figures are based principally on dry "kata" cooling powers necessary to prevent pronounced sweating and feeling of oppressiveness, the wet "kata" cooling powers being those values which would generally correspond to the value of dry cooling power, in climates like that of England.

The figures, moreover, apply to persons wearing ordinary clothing. Clothing makes a considerable difference, the cooling power on the body with ordinary outdoor spring clothing being about 50% to 60% of that of the naked body. The native stripped to the waist while working in hot conditions underground gives himself a great advantage over the clothed white man.

Dr. Haldane, as a result of investigations into the effects of hot and humid atmospheres, recommends the wet bulb temperature as the standard of comfort; but the latter does not take into account the important factor of *motion* of the air, and is a just standard for still air only.

In Table 1 are given values of cooling power by wet "kata" thermometer, with the corresponding physiological effects which are likely to be produced. When the dry cooling power exceeds 8 to 10, sweating ceases and the dry cooling power should then be taken as the standard of cooling, if the skin and clothes are dry. When the skin is flushed and moist and the clothes are wet, and wet cooling powers are above 25 units, there is great danger of producing chill unless hard

What the Kata-Thermometer Is and How it Operates.

The kata-thermometer is an alcohol thermometer with a large cylindrical bulb about 4 cm. long and 1.7 cm. in diameter, with a stem about 20 cm. long, graduated from 95° to 100° F. The range, 95° to 100° is more or less arbitrarily chosen to give a mean temperature of 97.5° F. (or 36.5° C.), which is approximately that of the clothed body surface.

A small reservoir is provided at the top of the stem to give a margin of overheating without bursting the bulb, to give time to place the instrument in the position required and to allow the rate of cooling to become steady before the meniscus has fallen to 100°.

In taking a reading of cooling power on dry surface, the bulb is used bare and is heated in hot water (at about 80° C.) until the alcohol rises into the top reservoir and all air bubbles have been driven to the top of the meniscus. A thermos flask is very convenient for holding the water and keeping it hot during a short series of readings.

The bulb and stem are then dried and the instrument suspended in the position required.

The time in seconds for the meniscus to fall from 100° to 95° is taken, preferably by a stop watch. Each instrument is carefully calibrated and marked on the back of the stem with a factor, or coefficient, such that the factor, divided by the time of cooling in seconds, gives the cooling power in millicalories (1/1000 gram calories) per square centimeter of cooling surface per second.

In other words, the factor is the time of cooling in seconds necessary to give a cooling power of 1 millicalorie per square centimeter per second. In all instances when figures of cooling power are given it should be understood that they refer to millicalories per square centimeter per second.

The wet cooling power is taken in a similar manner to the dry. The thin lisle thread finger stall supplied with the instrument is drawn over the bulb which is heated in hot water. The surplus water is then shaken off, the instrument exposed in the required position, and the time of cooling taken.

Where the cooling power varies, owing, for example to fluctuating drafts, several readings of each kind, perhaps five, should be made and the averages taken as the true values.

work is being done and thermogenesis thereby maintained.

TABLE 1.—VALUES OF COOLING POWER BY WET AND DRY KATA-THERMOMETER, WITH CORRESPONDING PHYSIOLOGICAL EFFECTS.

Cooling Power Wet "Kata"	Cooling Power Dry "Kata"	Physiological Effects on Man Stripped to Waist
5	1.5	Extremely oppressive; profuse sweating; rise of body temperature and pulse rate, especially when work is performed. Very small evaporation from respiratory tract.
10	3.5	Distinctly oppressive; body temperature can be kept nearly normal only by profuse sweating. Skin flushed and wet. Pulse rate high.
15	5.5	Lower limit for comfort.
20	8.0	Quite comfortable for work.
25	10.0	Cool and refreshing for work; too cold for resting, especially after being heated.

EFFECTS OF ATMOSPHERES OF LOW COOLING POWER.

The effect of atmospheres of low cooling power on the human system is to divert the blood circulation from its normal course through the brain and the viscera, and to some extent from the muscles, to the cutaneous blood vessels in a strenuous attempt to get rid of heat. The blood pressure falls, owing to the dilation of these blood vessels, but the pulse rate is greatly accelerated and the work of the heart thereby increased. If carried to extremes, dizziness is caused, and digestion and other vital processes are temporarily inhibited, if not entirely suspended.

The diversion of the blood stream from the muscles leaves them with impaired nourishment and reduced means of washing away waste products and consequently muscular fatigue is greatly accelerated; moreover, the feeling of oppression, the increase of internal work, and the lack of blood flow in the eliminative organs greatly conduce to general fatigue, as distinct from muscular fatigue. These factors explain the common complaints, "no appetite for food," "no energy," etc., from men working in hot, opressive atmospheres underground.

LAWS GOVERNING THE RELATIONS BETWEEN COOLING POWER AND THE SEPARATE FACTORS OF TEMPERATURE, HUMIDITY, VELOCITY AND DENSITY OF AIR.

To determine the laws governing the relations between cooling power and the separate factors of temperature, humidity, velocity and density of air, a series of experiments was carried out by Hill and his collaborators, in which wet and dry "kata" readings were taken with variation of these factors. The following relations were established:

Let Hd = cooling power by dry "kata."
Hw = cooling power by wet "kata."
t = temperature of air in degrees centigrade.
Φ = excess of "kata" temperature over temperature of air = 36.5° — t.
V = velocity of air movement in meters per second.
F = vapor tension in millimeters of mercury at 36.5° C. = 45.6 mm.
f = vapor tension of the air.

Dry "Kata" Formulae:

In still air, $Hd = 0.27\Phi$ (1)

In wind with velocity less than 1 meter per second,

$$Hd = (0.2 + 0.4\sqrt{V})\Phi \quad (2)$$

In wind with velocity less than 1 meter per second,

$$Hd = (0.13 + 0.47\sqrt{V})\Phi \quad (2a)$$

Wet "Kata" Formulae:

In still air, $Hw = Hd + 0.085\ (F-f)^{4/3}$ (3)

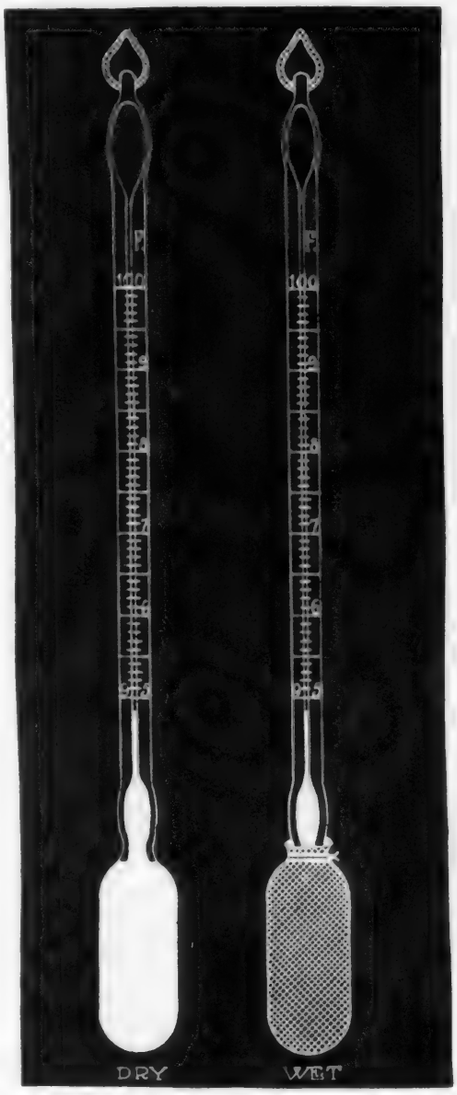
In wind with velocity less than 1 meter per second,

$$Hw = Hd + (0.06 + 0.073\sqrt[3]{V})\ (F-f)^{4/3} \quad (4)$$

In wind with velocity greater than 1 meter per second,

$$Hw = Hd + (0.025 + 0.098\sqrt[3]{V})\ (F-f)^{4/3} \quad (4a)$$

Formulae (2) and (4) do not hold good with velocities less than 0.04 meters per second, as this gives practically the same cooling as still air.



THE KATATHERMOMETER.

Considering equation (1), the cooling power is produced partly by radiation, and partly by convection currents set up by the hot bulb of the "kata," and at ordinary temperatures and pressures approximately half the heat is lost by radiation, and half by convection. The heat lost by convection will vary as the square root of the density of the air, that is, as the barometric pressure, while the heat lost by radiation will be independent of barometric pressure.

If H_1 = cooling power at pressure p_0 height h_1
H_0 = cooling power at pressure p_0 and sea level

Then $H_1 = H_0/2 + H_0/2\sqrt{p_1/p_0}$

$$\text{or } H_1 = H_0\left(\frac{1+\sqrt{p_1/p_0}}{2}\right) \quad (5)$$

That is, the percentage change in cooling power is approximately one-fourth of the percentage change in pressure. This formula, which is the one given by Dr. Hill, obviously applies only to still air cooling. We suggest the following as a general formula to include wind conditions for pressures different from that at sea level:

$$H = \left(0.13 + 0.07\sqrt{\frac{p_1}{p_0}} + 0.4\sqrt{\frac{Vp_1}{p_0}}\right)\Phi \qquad (6)$$

to replace (2)

$$\text{and } H = \left(0.13 + 0.47\sqrt{\frac{Vp_1}{p_0}}\right)\Phi \qquad (6a)$$

As H is proportional to Φ, the dry cooling power, say (H_2) of a hot surface at a temperature (t_2) other than 36.5° C., can be derived from cooling power H_1 at 36.5° C. by the equation

$$H_2 = H_1 \ (\Phi_2/\Phi_1)$$

where Φ difference between 36.5° and air temperature and $/\Phi_2$ is difference between $/t_2$ and air temperature. This formula is useful for taking out values of cooling power at skin temperatures which are usually lower than 36.5°.

To find the wet cooling power at a temperature ($/t_2$) other than 36.5° C., after substituting in equations (3) or (4) the new value of Hd, substitute for F the vapor pressure at temperature $/t_2$.

The equations given by Dr. Hill, which include (1) to (4),

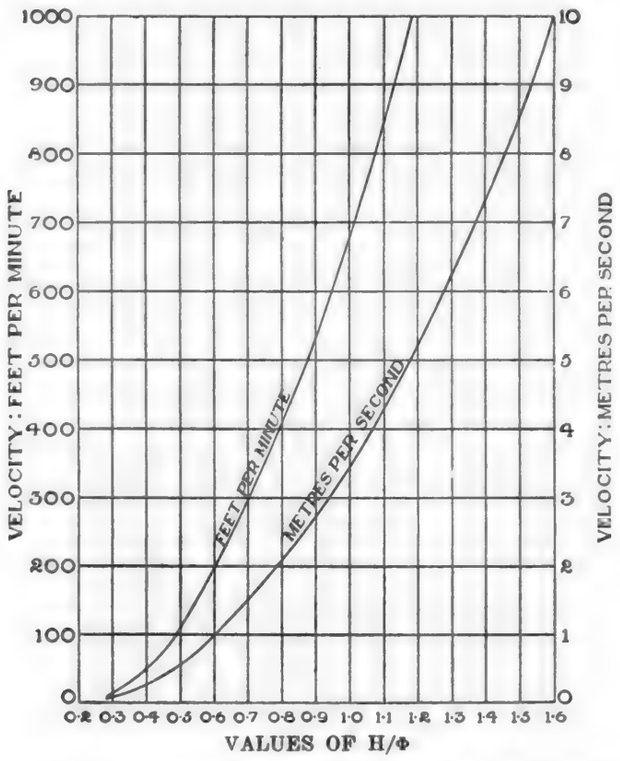


FIG. 1—RELATION BETWEEN VALUES OF H/Φ AND AIR VELOCITY.

also (5) and (7), have all been tested and proved experimentally. These formulae can be used to calculate values of wet and dry cooling power, when the temperature, vapor pressure, and velocity of the air are known, and, in the case of the outside air, from meteorological records. They can also be used to analyze kata-thermometer readings and to determine what part each factor is playing. This is particularly useful when one is setting out to alter conditions.

An examination of equations (2) and (4) shows how the cooling powers both by wet and dry "kata" are considerably increased by wind or air motion. The effect on the dry cooling power will perhaps be more clearly shown by the curves in Fig. 1 giving the relation between values of H/Φ and air velocity. For example, assuming that the air temperature is 25.5° C. (78° F.), then $\Phi = 36.5 - 25.5 = 11$; an increase of velocity from zero to 1 meter per second (197 feet per minute) will increase the value of H/Φ from 0.27 to 0.6, or the value of H from 3 to 6.6, that is, from distinctly oppressive to refreshing conditions. To get the same increase of cooling power in still air the temperature would have to be lowered to 12.1° C. (54° F.). It is quite evident which is the easier method of obtaining the result. As a matter of fact, it is difficult to overstate the importance of air movement in obtaining good conditions.

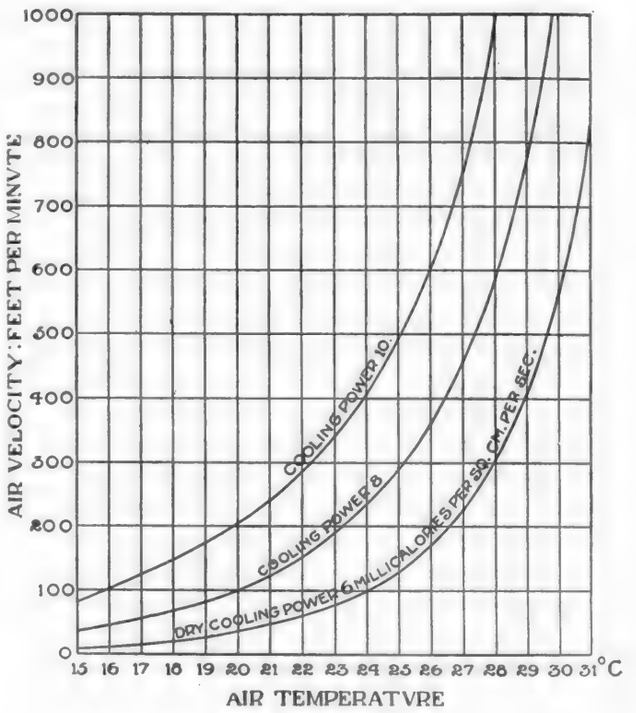

AIR VELOCITY: FEET PER MINUTE
COOLING POWER 10
COOLING POWER 8
DRY COOLING POWER 6 MILLICALORIES PER SQ. CM. PER SEC.
AIR TEMPERATVRE

FIG. 2—RELATION BETWEEN TEMPERATURE AND WIND VELOCITY.

In Fig. 2 curves are given showing the relation between temperature and wind velocity to give cooling powers of 6, 8 and 10 by dry "kata," the values given by Dr. Hill for sedentary work, light manual work, and heavy work, respectively. It will be observed how rapidly the required velocity rises as the temperature approaches 25° C. (77° F.) for cooling power 10, and 30° C. (86° F.) for cooling power 6. This illustrates the advantage of cooling the air down to, let us say, 25° C. at least, after which adequate cooling power can be obtained economically by local circulation.

It should be noted that air movement, so far as it affects cooling power, is not limited to unidirectional current but includes every eddy or swirl which helps to remove the warm, humid air from the clothes and skin. Thus air, the velocity of which cannot be determined by the anemometer, may have considerable cooling power due to eddy motion; consequently, direct readings of cooling power by the kata-thermometer are preferable to calculated values. From equations (2) and (2a), if the temperature and cooling power are known, we can calculate the velocity (or equivalent velocity) of the air. If the stream lines of the air are fairly regular, as in air flowing through long parallel passages, the kata-thermometer can be used as an anemometer in conjunction with an ordinary thermometer, the velocity being calculated in meters per second from equation (2), or taken from curves similar to those shown in Fig. 1.

As the kata-thermometer measures only its own rate of cooling, its readings have either to be translated into approximate physiological effects, as given previously in Table 1, or their relation given to the actual cooling of the human body;

for all practical purposes the former method is good enough, though the latter is interesting and useful for research purposes and for estimating from the metabolism how much heat is generated in the body. From observations carried out on various subjects Dr. Hill estimates that the heat dissipated from unit surface of the body of a person ordinarily clothed, in cool outside conditions when no decided sweating occurs, is from one-sixth to one-seventh of the dry "kata" reading corrected to the skin temperature of the cheek. The conditions will, of course, change immediately upon the occurrence of sweating. It does not necessarily follow that two different sets of conditions (temperature, humidity and motion) which give identical readings on the "kata" will produce identical effects on the body. The kata-thermometer readings, moreover, give no reliable indication of the evaporation from the respiratory tract, this being dependent *not* on the motion of the air, but on the amount of air breathed and its absolute moisture content, which latter can be found from wet and dry-bulb readings; some allowance should, therefore, be made for this factor in extremes of dryness and humidity.

VALUE AND METHOD OF STEAM GENERATING PLANT INTERCONNECTION

A Significant Evolution of the "Central Station" and "Block Plan" Idea That Has Already Proved Its Advantages

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(From a paper presented at the annual convention of the National District Heating Association at Cedar Point, O., June 20-23)

EDITOR'S NOTE.—*Heating groups of buildings from a central plant is, of course, the well-known method which has been extensively developed in the middle West and western sections of the country. In an effort to eliminate some of the losses which are inherent in this method, due largely to the high investment charge, the "block plan" system has been used with considerable success. This scheme, however, also has its limitations. It is now proposed to combine the salient features of the two methods in what has been described as the "interconnection plan." This has worked out so satisfactorily in one instance that its adoption is already assured in other cities now operating on the "central station" plan. It therefore constitutes a development of the district heating idea which is likely to mark a distinct epoch in the industry.*

WITH few exceptions, all central station heating companies operate under one or more of three plans:

1. *Block Plan,* in which a steam-generating plant is acquired in a given block and adjoining building supplied with steam service from that plant. The radius of distribution is quite limited and usually confined to the block in which the plant is located.

This plan of operation requires very little investment on the part of the heating company as a boiler plant; in most cases can be leased from one of the buildings. The distribution piping is small, and being run through the building basements, eliminates the great expense of underground construction.

On the other hand, the boiler plant is one of average efficiency, usually requiring an excess of labor, and the cost of steam production is high. This is especially true for the warmer months when the steam output is low, the amount of plant labor being practically the same as that required for a steam production several times as great.

2. *Central Station Plan,* in which the steam is generated in a strictly modern steam-generating plant and distributed through high pressure underground piping to buildings and other steam users at considerable distance from the source of supply.

Owing to the high efficiencies obtainable in such a boiler plant, together with the labor-saving devices now employed, the cost of steam generation is lower than that of a block plant. Taking into account the investment charge, this saving is not so attractive, and the total cost of steam, delivered to the customer, may be greater than that for the block plan of distribution. From theoretical estimates made by our engineers for a central station in Chicago, the cost of steam, taking into account the high investment charge which we would necessarily have, did not show any saving over that of the block plant.

TABLE 1. DATA ON STEAM SERVICE FOR SYSTEM SHOWN IN FIG. 1.

	Volume Cu. Ft.	Radiation Sq. Ft.	Max. Load lbs. Steam Per Hour	Avail. Boilers No.	Rated H.P.	Av. Yearly Steam Consumption Pounds	Steam Service	
Baltimore Bldg.	550,000	5,000	4,500	4	1,700	10,000,000	Heat., H. W.,	Cook.
Cont. & Coml. Bank	13,000,000	95,000	31,000	4	2,000	80,000,000	" "	Refrig.
Edison Bldg.	7,500,000	65,000	19,000	3	1,628	36,000,000	" "	
Insurance Exchange	9,500,000	75,000	23,000	4	1,400	50,000,000	" "	
Majestic Bldg.	2,000,000	28,000	9,000	5	1,150	16,000,000	" "	
Republic	3,500,000	30,000	10,000	4	500	36,000,000	" "	Cook
Central Trust Bank	1,200,000	6,000	4,000			10,000,000	" "	
Chicago Savings Bank	1,500,000	17,000	5,700			15,000,000	" "	
Consumers Bldg.	2,500,000	35,000	9,000			18,000,000	" "	
Crilly Bldg.	1,000,000	11,000	6,000			15,000,000	" "	Cook
Fair Store	11,000,000	60,000	13,500			50,000,000	" "	"
Great Northern-Majestic	2,600,000	25,000	12,000			30,000,000	" "	
Lakeside Bldg.	1,500,000	14,000	3,000			10,000,000	" "	
McVickers	1,000,000	10,000	3,600			6,000,000	" "	
Marquette	4,300,000	40,000	14,000			35,000,000	" H. W.,	Hyd. Elev. Cook.
Merchants' Loan & Trust	2,300,000	26,000	8,600			20,000,000	" "	
Peacocks	600,000	6,000	2,000			4,000,000	" "	
Postal Telegraph	3,250,000	30,000	17,000			45,000,000	" "	Hyd. Elev., Cook.
Spalding	500,000	5,000	2,000			3,000,000	" "	
Total of 31 Misc. Cust.	15,000,000	115,000	60,000			81,000,000	" "	Cook.
Total	84,300,000	698,000	256,900	24	8,378	570,000,000		

Boilers in these buildings not used.

3. *The Interconnection Plan,* which is a compromise between the block and the central station plans. In this scheme of operation and distribution, high-pressure tie lines are run between plants already operating on the block plan. One of the plants is made the nucleus of the system, and being operated near capacity throughout the entire year, should be provided with coal and ash-handling equipment, togther with such other apparatus as will lead to the greatest efficiency and a resultant low production cost.

The investment charge is slightly greater than that of the block plan, but very much less than in the case of the central station. By operating the less efficient plants only in the very coldest of weather and supplying the entire service from one station during the summer months, the labor is reduced to a minimum, and the efficiency of the system is at its best. Compared with either of the other two plans, this method of steam generation and distribution appears the most attractive and has resulted in great savings, as proven by our experience in Chicago.

In discussing the "Value and Method of Steam Generating Plant Interconnection,' a description of one of the systems of the Illinois Maintenance Company, together with its operating data may be of interest.

PLANT-INTERCONNECTION SYSTEM OF THE ILLINOIS MAINTENANCE COMPANY.

A plan of the system is shown in Fig. 1. It comprises six steam-generating plants, supplying steam service to fifty buildings and customers in thirteen city blocks in the loop district of Chicago. The present system is a result of interconnecting what were formerly six small systems, this being accomplished by means of high-pressure tie lines. The principal customers, size and character of the load are given in Table I.

Average loads on the system for each hour of the day for various mean daily outside temperatures are given in Fig. 2. During the summer months, with a mean temperature of 70° F. or warmer, the day load is approximately 42,000 lbs. of steam per hour, while the night load is 15,000 lbs. per hour. This results in a load factor of approximately 50%. A mean daily temperature of 60° F. introduces short hour heating in which the steam is used for a few hours in the morning and then turned off for the remainder of the day. The load factor for such conditions is quite low, usually less than 30%.

As the weather becomes colder, twenty-four hour heating is required, and the load curve flattens out, giving a high load factor—usually 70% for the months of December, January and February. A curve showing the average monthly load factors for the year is given in Fig. 3. The average yearly load factor for the system is 33%.

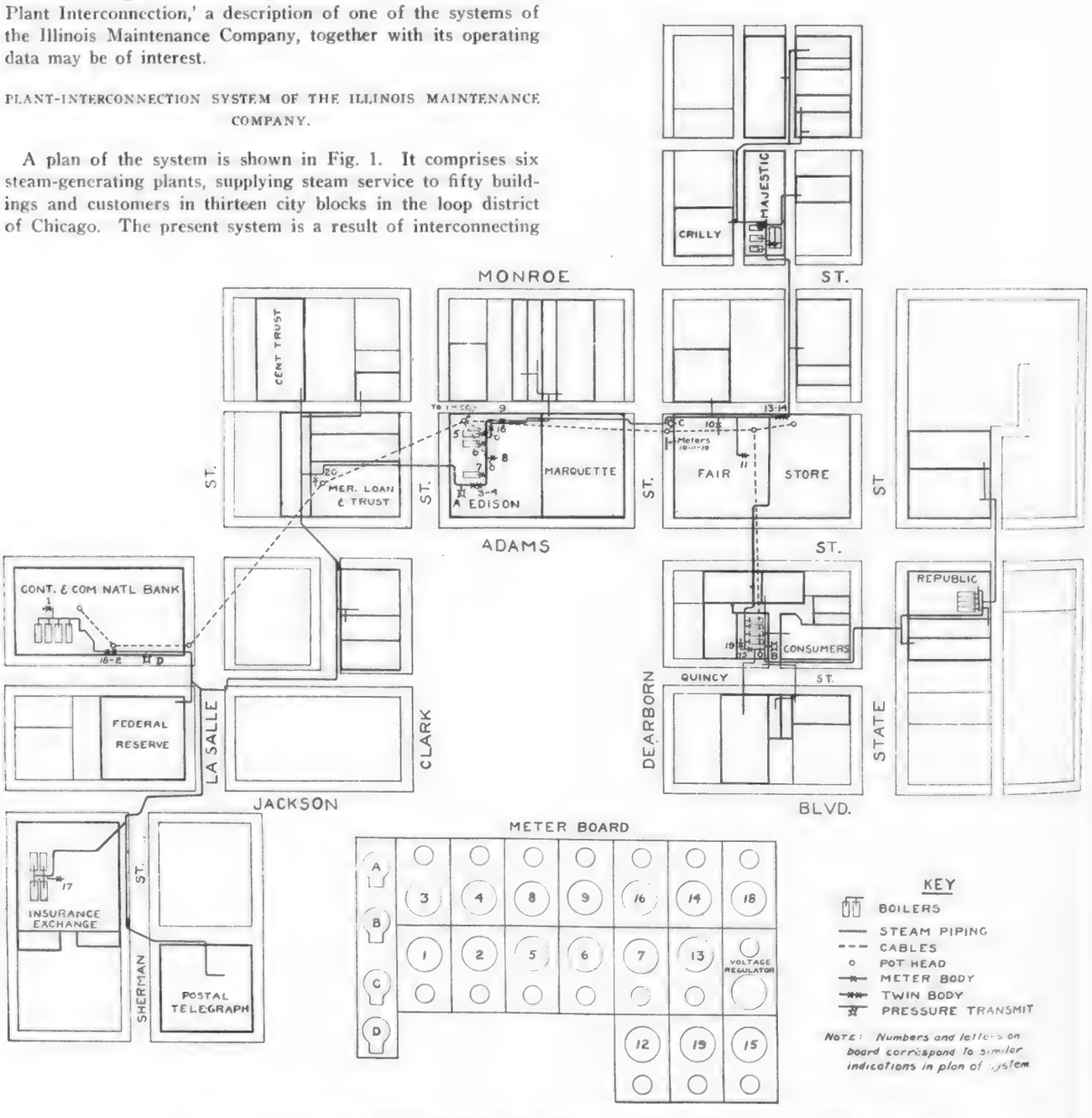

FIG. 1—PLANT INTERCONNECTION SYSTEM OF THE ILLINOIS MAINTENANCE COMPANY.

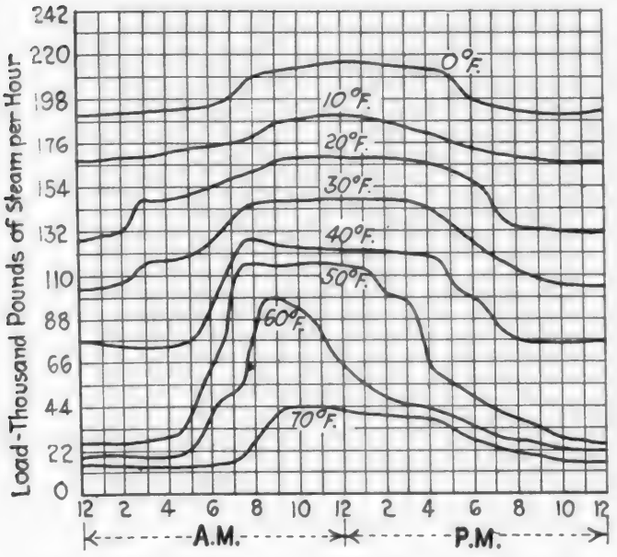

FIG. 2—HOURLY LOAD CURVES FOR VARIOUS MEAN DAILY TEMPERATURES.

HOW THE BOILER PLANT OPERATION IS HANDLED.

With steam generating plants and customers distributed over thirteen city blocks, it was necessary to install some system of load dispatching in order to properly handle the boiler-plant operation in accomplishing the desired results. A meterboard with integrating and recording Republic flow meters, together with Bristol long-distance electrically-operated recording pressure gauges was placed in the office of the chief operating engineer, eleventh floor of the Edison Building; and this, together with the telephone, was considered sufficient for the successful operation of the system.

A boiler record board giving the total boiler horsepower in service, boilers banked, and spare boilers, is also included with the load-dispatching equipment. Each boiler is represented by a block, the length of which corresponds to a given rated horsepower for that boiler. By placing these blocks end to end and having a horse-power scale, the total for any group at any time may be learned at a glance.

To make the load-dispatching system as flexible as possible and also provide for future extensions and additions, lead-covered telephone cables (see Fig. 1) parallel the main steam lines with potheads and terminal boxes at the more important points. The terminal box in the basement of the Edison Building has a capacity of fifty pair, and a fifty-pair cable extends from there to the terminal cabinet on the eleventh floor.

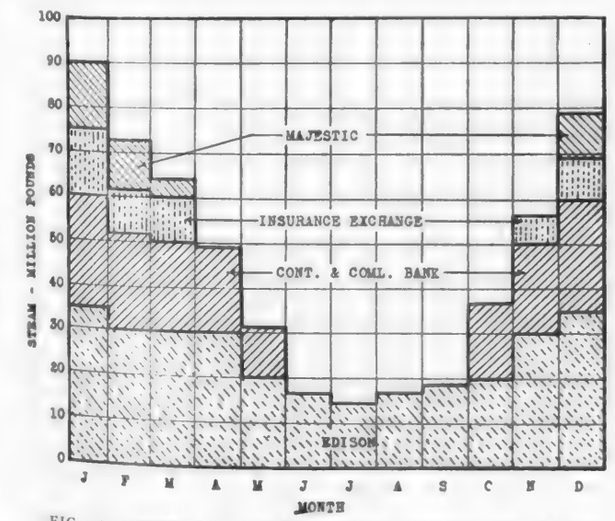

FIG. 4—MONTHLY STEAM PRODUCTION FOR EACH OF THE SIX PLANTS BEFORE BEING INTERCONNECTED.

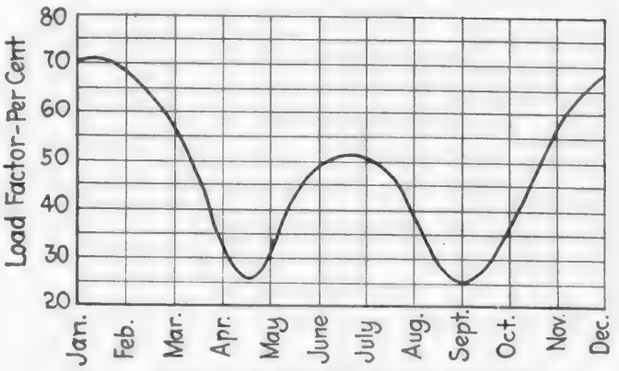

FIG. 3—AVERAGE MONTHLY LOAD FACTORS OF SYSTEM.

Steam lines, in which the direction of the steam flow may reverse at different periods of the day or year, are provided with twin-meter body installations. Each requires two sets of metering instruments, one meter registering flow in one direction, and the other registering steam flow in the opposite direction.

The majority of the meters are placed on main steam lines or service connections with large loads. In this way the necessary information can be obtained with a minimum of instruments. The steam-generating plant in the Edison Building being the central and principal producer, meters were placed on the individual boilers. In some cases duplicate or additional instruments were placed in locations other than the office of the chief operating engineer.

The recording instruments on the meter board have seven-day clocks, and in the case of the flow meters, are operated electrically from the master clock of the building. The flow meters are also provided with indicating scales, making it a simple matter for the dispatcher to obtain the information which he uses in posting his load curves, they being added to hourly.

Fig. 4 shows the monthly steam production for each of the six plants before being interconnected. It will be seen that during the winter months the plants are not operating at capacity, while during the summer they produce very little steam. The monthly steam production, after the interconnection, is shown in Fig. 5. The Baltimore and Republic plants are shut down completely, the Majestic is operated for four months, the Insurance Exchange for five months, and the Continental and Commercial for eight months, while the Edison is operated throughout the entire year.

Under this plan, each plant is operated as near its capacity

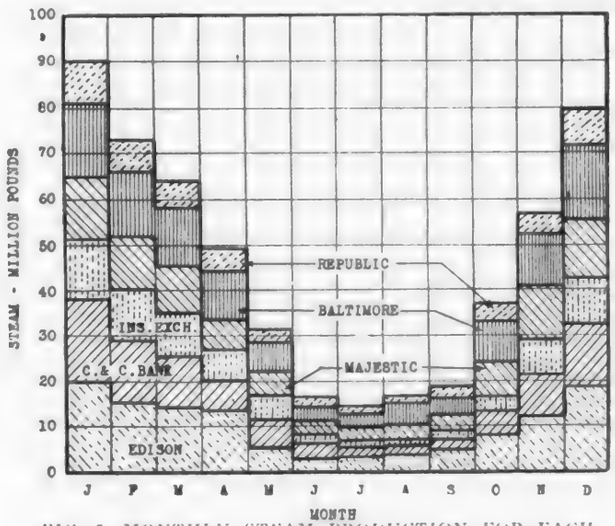

FIG. 5—MONTHLY STEAM PRODUCTION FOR EACH OF THE SIX PLANTS AFTER BEING INTERCONNECTED.

as possible when in service, thus resulting in a much better efficiency. The interconnection also makes it possible to use the plants where the steam can be produced the cheapest, the more expensive producers being used only in the very coldest weather. Boiler capacity, which in some cases could not previously be used for taking care of new business, due to the limited range of distribution, is now available, owing to the flexibility of the system.

The total available rated plant capacity amounts to 8,378 H.P. Plant capacity factors (ratio of steam produced to that available in the plants operated, assuming 100% boiler rating) when operated separately vary from 48% as a maximum to 7.9% as a minimum, with an average for the year of 24.8%. When interconnected, this variation is from 65.0% to 38.8%, with a yearly average of 52.5%.

SAVINGS THROUGH BURNING OF CHEAPER GRADES OF COAL.

The greatest fuel saving is made by burning the cheaper grades of coal in the Edison and Continental plants in preference to the No. 4 coal required in the other plants of the system. The Springfield boiler being provided with a forced draft stoker for burning coke breeze or anthracite screenings, has been operated almost continuously at 200% of rating, burning

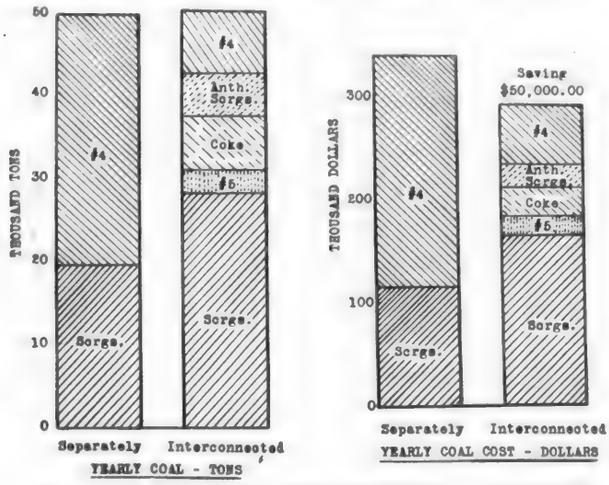

FIG. 6—YEARLY COAL REQUIREMENTS OF SYSTEM BEFORE AND AFTER INTERCONNECTION.

over 1,000 tons of coal monthly at a saving of $2.00 to $2.50 per ton. The total annual fuel saving for the system was approximately $50,000.00. Fig. 6 gives the yearly coal requirements of the system both before and after interconnection, as well as the coal cost for that period.

Another benefit of the interconnection has been the great saving in plant labor. The monthly hours of labor necessary to operate the plants separately varied from a maximum of 19,000 hours for January to a minimum of 10,700 hours for July or August, with a total of 168,900 hours for the year. Expressing this in hours of labor per thousand pounds of steam sold, the amount increases from 0.211 in January to 0.725 in July, with a yearly average of 0.310.

Upon interconnection, the labor in two of the plants was saved throughout the entire year, while a saving was made in three of the plants during the summer months. In this way the January labor was reduced to 13,000 hours and the summer labor to 2,500 hours per month, with a total of 83,000 for the year or a saving of 85,900 hours, which at seventy cents per hour amounted to an annual saving for labor alone of approximately $60,000.00.

In conclusion, the advantages of the interconnected plan can be briefly summarized as follows:

1. Low investment cost. When one of the block plants is of ample capacity to take care of the average system load and is efficient in operation, this investment will be limited to distribution piping Otherwise it may be necessary to make some investment in the steam generating plant which is to be made the nucleus of the system.

2. Saving in fuel cost by producing the bulk of the steam in plants burning the cheaper grades of coal.

3. Increased plant efficiencies as a result of operating boilers at high ratings when in service.

4. Saving in labor, due to the closing down of plants during certain periods of the year. Also by producing greater amounts of steam with the same labor in plants which are operated.

5. Releasing of boiler capacity which otherwise could not have been used owing to the limited business in the immediate territory.

6. Strengthening of the service. This is of importance where high pressure steam is required and continuity of service desired.

Relation of Heat to Power and the "Superpower" Plan.

Enthusiasm for the "Superpower Plan," which has been so much before the public of late and which involves, at present, the extension and improvement of our existing system of electrically-connected steam and water power plants along the North Atlantic seaboard, should not blind the engineering public to the enormous advantages possessed by the individual factory power plant in the production of economical power, an advantage entirely lacking in the modern central station of the "superpower" class. This point is taken up by David Moffat Myers in a recent issue of *Chemical and Metallurgical Engineering.*

Mr. Myers points out that the central, or so-called "superpower," station has a single object to fulfill—i. e., to supply consumers with power and with power alone—whereas the natural and unavoidable product of every steam power plant is not only power, but heat as well. Furthermore, this product divides itself again into about 20 parts of power and 80 parts of heat. These 80 parts of heat are absorbed by the cooling water of the condenser and wasted. When a condenser is not used, 86% to 95% of the heat is available in the exhaust for heating and about 4% to 12% converted into mechanical energy. The central plant has no market for this heat, to produce which it has been compelled to consume four-fifths of its coal.

USE OF EXHAUST HEAT FOR HEATING PURPOSES.

The usual industrial plant, on the other hand, has frequently a very large demand for heat as well as power. In many cases and in numerous kinds of manufacture all or the major part of this exhaust heat can be utilized for processes and for the heating of buildings. In the majority of industrial plants heat is needed for the plant during the cold months of the year. In all such industries all or a portion of the otherwise wasted heat which is a pure by-product of their power generation can be effectively utilized to take the place of its equivalent of direct steam from the boilers. Thus, for example, in an industry where there exists a large demand for heating and process steam the economy of the situation would be represented approximately by the following comparison:

Case 1. Combination power and by-product heating. 5% to 10% of the heat of the steam converted into electrical energy to supply the power demands; 90% or more for heating and process work; no steam wasted.

Case 2. Power and heat from separate sources, the former from a super-power plant, the latter from a boiler plant in the industrial establishment. The boiler plant will have to produce 90% as much heat (steam) as in case 1, and at the same time it will be necessary to buy power which has been made with an 80% waste of steam and is consequently proportionately expensive, since the consumer must pay for the 80% waste of steam as well as for the power.

Each industrial plant has its own particular requirement for so much heat and so much power, but the more heat it requires the more cheaply can it make its own power as a by-product of its heating and process steam. There are many plants which require little or no heat. Here power alone obtained at the lowest cost is required. Whether such an industry should own its plant or buy its power is purely a question of the engineering economies of the situation.

HEAT LOSSES FROM BUILDINGS AS AFFECTED BY METHODS OF USING THE HEAT GENERATED

An Analysis of the Different Ways Efficiency of Plant is Reduced, with Suggestions for Improving Operating Conditions

BY S. HOMER WOODBRIDGE.

THE topics considered in the immediately preceding papers have had reference to conditions affecting the rate of escape of heat from buildings due to the forms of structure, to the materials and the methods of construction, and to the types of insulation employed. It remains to note the effects on the rate of thermal loss of the methods of generating and of using heat for purposes of warming.

HEAT LOSS IN THE PRODUCTIVE PROCESS.

The percentage of heat which is lost from that generated by the burning of fuel ranges from 95% for the least efficient form of open fire-place to possibly 5% for the most efficient form of effectively used stove. It is not within the scope of the present paper to discuss the inherent economic features and values of the several forms of fire chambers and related constructions of hearths, stoves, furnaces, boilers, heat conduits, and of convectors or radiators employable for the production, the transference, and the delivery of heat as employed in the several processes of warming. One or two essential matters only, common to them all, will be considered in the present study.

LOSSES DUE TO INCOMPLETE COMBUSTION OF FUEL AND FAULTY DRAFT CONTROL.

Perfect combustion of any fuel used is of major economic importance. Carbon burned to carbon monoxide (CO) yields less than one-third the heat given by the same carbon burned, or oxidized, to carbon dioxide (CO_2). Hence the waste attending either an insufficient supply of air to fuel, or so large a supply as to lower the temperatures of fuel and air sufficiently to prevent complete oxidation. For the purpose of this study perfect combustion is assumed. Even then there may be, and there commonly are, serious wastes attending heat generation, due principally to two causes; first, the needless carriage of unutilized heat to chimney and waste; and, second, the escape of heat from fire chambers through fire chamber walls into building spaces where its utilization is impracticable and waste is commonly inevitable.

Waste to chimney may result because of an excess of air passing through the fire box, with a corresponding lowering of the temperature of combustion gases, or by an excess of temperature of the combustion gases as they pass to the chimney. If a chimney is so proportioned as to height, cross section and form that a temperature of 200°F. in the escaping gases above that of the outside air will produce all needed draft through the fire, then all chimney temperature above that 200° increment represents waste. If 18 lbs. of air fed to each pound of coal burned are required for complete combustion, then each rise of 20° above that chimney temperature represents a loss of 1% in fuel, on the basis of 8,500 B. T. U. normally available per pound of coal. Therefore the economy of employing effective, if inexpensive, means for extracting all permissible heat from combustion gases before their escape to chimney, and in avoiding the waste entailed through neglect to provide such means.

Because increase in air quantity above the normal required for complete combustion means a lowering of the temperature of combustion gases, and the larger volume of those gases, and their quicker travel through and away from the heat-absorbing surfaces, and also a lessening of temperature difference between the combustion gases and the surfaces of boiler or other device provided for the absorption of heat from those gases, it follows that combustion gases yield less heat per pound of air to such surfaces, and that the ratio of escaping heat to the chimney is proportional to the air quantity fed to the fire. Computation makes it appear that if the heat made available when the air supply is 18 lbs. per pound of well-burned coal, with each increment of 1% in the quantity of air above that normal the decrement in the available heat from the fuel is approximately 0.50%. Hence the large economic importance of correct draft control, and of preventing air leaking through the walls of the fire container, or the boiler setting. These phases of our subject, here merely touched upon, must be passed without further notice.

HEAT LOSS THROUGH WALLS OF COMBUSTION CHAMBERS

A third source of heat loss at the point of, and during the process of, heat production is in the escape of heat by conduction through and from the walls of the fire chambers to surrounding air or materials, where its presence is only wasteful and often discomforting due to the overheating of firing rooms and adjacent quarters. Such wastes, quite apart from the heat escaping through chimneys, may reach proportions equal to from 10% to as high as 15% of the available heat producible by the fuel burned.

Thus, if a school house, as ordinarily built, requires in zero weather 5 H. P. in boiler capacity for properly warming and adequately ventilating each contained school room, a twelve-room school building provided against such weather would require a boiler power equal to 60 H. P. nominal, all power above nominal rating being reserve for other demands, especially those of exceptionally severe weather including high winds and heavy cloud.

Let the boilers be two of 30 H. P. each. The total surface of brick setting would commonly approach 900 sq. ft. The rate of coal burning in zero weather would be 240 lbs. per hour, yielding to the building for warming and to air for ventilation 2,040,000 B. T. U., approximately 1,200,000 B. T. U. being lost through chimney requirements and waste, and through brick setting surfaces to surroundings. If the loss through walls of boilers is no more than 8% of the available heat, or 163,200 B. T. U. per hour, then in the mean "closed-season" weather the wastage through boiler walls may average 81,600 B. T. U. per hour, or 91 B. T. U. per hour per square foot of surface of boiler setting, a quantity sufficient for the warming of two or three of the school rooms.

That heat may be largely or wholly conserved by making the surface of the boiler setting part of the heating system by employing it for the warming of air for ventilating work. Objections may be offered by the unthinking, and pressed by the prejudiced, against such use of boiler brickwork; first, because of the resulting chilling effect upon the boilers, and, second, because of the harmful hygienic effect of gas leakage from the fires through the walls into the air warmed by the conserved heat.

Such objectors ignore the fact that the very purpose in such case of generating heat is to impart it to the building for warming, or to the air for ventilating, service, and that the more direct and speedy the transfer of generated heat to its intended function, the higher the economy. The hygienic objection may be better grounded, and more serious, provided the needed precautions to prevent gas leakage are not duly taken. The liability of escape of gases from fires to air warmed by them is not peculiar to the brick setting of boilers, but is frequently found in the many jointed makeup of warm-air furnaces and stoves. In the one case the gases are separated from the air by brick walls of from 12 in. to 30 in. in thickness, and in the case of furnaces, by cast-iron plates varying from 3-16 in. to ¼ in. thickness, and both made up with joints filled with more or less porous cement. The opening of joints is more common in the case of furnaces than of boilers, because of the high heating and oftentimes severe warping of the cast-iron parts making up the furnaces.

Two rules properly applied to all such constructions will effectively prevent the contamination to any degree of outside air by inside gases; first, make the intercepting walls as tight as possible against the passage of gases through structural pores or apertures; second, so control the gas and air pressures within and without the combustion chambers that the air pressure without shall exceed the gas pressure within the fire-containing walls; in other words, increase the outside air pressure to an attainable maximum, and decrease the inside gas pressure to the attainable minimum. Hence the advisability of (1) filling the walls of boilers with a pure cement wash two or more times applied, (2) controlling fires by dampers on their draft feed side rather than on the chimney side, (3) of placing the fan, if used, in such position and giving to it such action that the fire walls shall be on the plenum, or "pushing" side of the fan rather than on the vacuum, or "pulling" side.

Only in one instance in which the writer has yielded to the convenience, if not the apparent necessity, of placing the fan on the vacuum side of a battery of boilers housed for conserving "waste" heat has the final result proved disappointing. Though the twin boiler walls were not cement-wash filled, as called for by the specifications, the working was successful for several years, but finally failed to the extent of contaminating, in fickle fashion, the air of uncertain rooms with coal gas when the accumulation of unremoved chimney soot, amounting to seven large ash cans full, had so choked the flue way as to seriously thottle the boiler draft. The designing engineer naturally suffered popular crucifixion for the sins of the operating engineer.

HEAT LOSSES INCIDENT TO WARMING BY RADIATION

Heat economically generated may be uneconomically applied to the warming of rooms and buildings. The least heat is lost from a warmed room having a cold exposure of from one wall to all walls when, (1) the warming is effected by warm air, and (2) in such manner that the mean temperature of the contained air is the minimum required for the intended use of the room, and (3) when that temperature is made uniform throughout the room. The greater the departure from those conditions the larger the heat loss and resultant waste.

When a room is warmed by a fire-place, a stove or a radiator, radiant heat is passed through, without warming, the air to the walls and other surfaces bounding or within the room. As those surfaces are warmed, and to the extent to which they are warmed, above the air within the room, they yield heat to the cooler air. The open fire-place warms entirely by that indirect method. The stove and the radiator warm by both radiation and convection in proportions varying greatly with conditions of form and exposure. The more thermally effective the form and exposure, the more nearly the methods of radiation and convection approach equality. It should be noted also that the warming of the interior walls of, and of surfaces within, rooms results in a larger heat yield by those surfaces by radiation to the outside or exposed wall or walls, thereby increasing the conduction rate through such wall or walls, and increasing proportionately the heat loss rate.

Whenever and however radiant heat is imparted to the inside surface of an exposed wall, the temperature of that surface is correspondingly increased, as is also the difference between the inner and the outer surfaces of the wall, and therefore the rate of heat transmission through the wall by conduction is increased. By as much as that conduction is increased, heat is lost, and that loss may be, and commonly is, more than an offset to the thermal gain attending direct radiation to the person from the heat source, and also attending reduced radiation from the body to the cooler-than-body surfaces.

VALUE OF HORIZONTAL EXTENSION IN HEATING SURFACES.

Radiators, and more commonly stoves, may be of such form and so placed and exposed as to produce by convection currents an overhead stratum of superheated air, with temperatures of the lower strata normal, a condition heretofore shown to be highly favorable to heat loss. Horizontal extension, rather than vertical or other concentration, of direct heating surface tends to the production of convection currents of large volume and correspondingly low temperature, and therefore to an equalizing of the temperatures of the strata of air within rooms. Furthermore, economy of installation favors such construction because the thermal value of surface in open and horizontal extension is largely in excess of the same surface in concentrated form.

Thus, 300 ft. of 1-in. pipe made up into a four-pipe "wall-coil" may have double the per square feet thermal value of the same pipe made up into a box-coil" of 10x10 pipes 3 ft. long. The air moving away from the "box-coil" may have a temperature rise of 75°, and that moving away from the "wall-coil" a rise of 20°. The corresponding volume of air moved by each is then in the ratio of 100 for the "box-coil" and 750 for the "wall-coil." If the "box-coil" effect is to rotate the air of a room once each half hour, the "wall-coil" will effect the same rotation in four minutes.

IMPORTANCE OF THE LOCATION OF RADIATORS AND HOT-AIR REGISTERS.

The economic effect of the location of radiators within rooms is large. Placed immediately beneath a window the results are (1) the offsetting of radiation from the body to the window by radiation from the radiator to the body; (2) the prevention of floorward cold drafts from the window and the consequent chilling of floor air; (3) the placing of the radiator in the coolest and most rapidly moving air within the room, thereby increasing the thermal output from the radiator to the maximum, and (4) a mingling of the currents of heated air rising from the radiator with the currents of the chilled air falling from the window, the effect being a rise toward the ceiling of an enlarged volume of air at correspondingly lower temperature, and with equalizing effect as to the temperatures of the several strata of air within the room. Heat loss and costly discomfort due to errors in the form and the placing of radiators are common.

WARMTH OF FEET AND COOLNESS OF HEAD TWO PRIME ESSENTIALS TO HEALTH.

When heated air is passed through floor registers and rises through the ambient air of rooms in gradually increasing vol-

ume and decreasing temperature, the action tends to produce all the wasteful results heretofore described as peculiar to superheated ceiling air. The column of heated air, rising from floor registers, or from stoves or radiators, passing upward draws toward and into itself by frictional and aspirating action successive quantities of the surrounding air which results in increasing the volume of the upward moving column and in decreasing the temperature. The proportional parts of the supply air (S), and of the ambient air (A) making up any ceiling air (C) may be found from the temperatures of those airs, as follows: Let T″ represent the temperature of the supply, T′ that of the ceiling and T that of the ambient air. Then the percentage of A in C is $\frac{T''-T'}{T''-T}$, and that of S in C is $\frac{T'-T}{T''-T}$. Thus, if A is 65°, C 85° and S 120°, the percentage of A in C is $\frac{120-85}{120-65}=$ 63.63%, and that of S in C is $\frac{85-65}{120-65}=36.36\%$.

FAULTY LOCATION OF WARM-AIR REGISTERS AND RADIATORS.

When a warm-air inlet through the floor is placed in close proximity to a wall, or worse still, in a corner, and when a radiator is so placed, the proportion of S in C is larger, and often much larger than when the hot air delivery, or radiator, is at greater distance from the wall or the corner. This is for the reason that by as much as the rising current of heated air is in close proximity with vertical surfaces, all movement of ambient air from the wall direction is retarded, if not prevented, and admixture of that air on the wall side with the rising column of heated air is prevented. Such positions of heat sources are therefore unfavorable to thermal economy by as much as the makeup of the ascending current tends to produce superheated ceiling zones.

REMEDIES.

By diverting heated air currents from the vertical to a horizontal direction of flow away from walls or corners, the gain will be proportional to the effectiveness of the divertion, or to the distance from walls to which the currents are diverted. A shallow box, of register size, with one side removed and placed bottom up over a misplaced register, and with removed side of box away from the wall, may, if rightly proportioned, reduce heat losses by lowering the temperature of the ceiling air and raising that of the floor air.

A horizontal delivery of heated air near the floor entangles and moves ceilingward more ambient air than the same entering current does when debouching vertically. The admixing effect is greatest when, due to the location and force of inflow, that current can be so entered and directed as to spread out fan-shape over the floor with a sufficiently rapid motion to cause the quiescent air above it to move downward upon it through the inductive action of the floor current. A sufficiently strong and continuous current moving over any plane surface imparts, by its frictional and entangling effects, a concurrent motion in the air films in contact with the rapidly moving air, which results in such a downward movement of air toward, upon and into the initial current as to hold and press that current close to the surface along which it travels, and at the same time, by the force of the current, to make it travel far from the point of entrance. In the placing and directing and performing of heated air currents are to be found economies too often overlooked.

ECONOMIC ADVANTAGE IN VENTILATING BY TEMPERED AIR.

In the case of heating rooms by direct radiation, and of ventilating them by air supplied at a temperature but little above that desired for occupied rooms, that ventilating air may be so entered at or near the top of rooms in forceful and diffused flow as to thoroughly mingle with the ceiling air, preventing the formation of an overheated ceiling zone, and bringing the entire air contents of the room to a practically uniform temperature. That effect is also producible in rooms where free ventilation is employed, and the ventilating air supplies the needed heat. In that case the temperature of the air supply is above that maintained in the rooms inversely as the rate of air supply. If the cubic contents of a school room is 12,000 cu. ft., and if the zero weather rate of heat loss is 32,000 B. T. U. per hour, and the desired temperature of the room is 68°; when the rate of "change of air" is once each ten minutes, the temperature of the air supply becomes 92.4°; when the rate of change is once in five minutes the temperature of air supply drops to 80.3°; if the change rate rises to once in two minutes, air temperature drops to 72.9°. The more free the ventilation, the more even, from ceilings to floors and from roof to basement, becomes the temperature of any building, and consequently the less the rate of heat loss.

NOTABLE EXAMPLE OF HEAT ECONOMY IN ROGERS BUILDING, M. I. T.

A notable example of economy obtainable through a correct regard, and application, of the principles set forth in this study has been furnished in the case of the Rogers Building, Massachusetts Institute of Technology. The exposed glass surface is about 13,000 sq. ft., the brick wall surface 29,000 sq. ft., the roof surface 14,000 sq. ft. The entire building is warmed by heat brought to rooms in ventilating currents. The zero weather air supply to the building equals a complete "change" once each seventeen minutes. The computed per hour heat loss for that weather, using a combined factor of 60 for leakage and orientation exposure, equals that yielded by 24000 lbs. of steam condensed at 212°. The average temperature of the air supply in zero weather is 97°. The average difference between the floor and ceiling temperatures as found in such weather rarely reached 3.5° The plenum pressure produced within the building by the ventilating method employed reduced the inward leakage of cold air. The heat for ventilation in the same weather equals that of 3900 lbs. condensation per hour, making a total of 6300 lbs. per hour, or the steam producable by 145 H. P. boiler capacity, with efficiency of 150% of rating.

The actual rate of condensation, as metered, for both heating and ventilating service in average zero weather was that equal to 115 boiler H. P., or approximately 80% of the sum of the cost of separate heating and ventilation by common methods, representing a saving of nearly 50 tons of coal a year.

The details of devices and of methods of their application directed to the attainment of efficiency and economy in the use of heat in warming work are far too numerous and varied to be even listed, and much less described, in such a study as the present, however tempting the opportunity to enter that interesting field. The purpose of the group of papers thus far offered on thermal economy themes has been to direct attention to certain basic principles involved in the economic application of heat generated for the warming of buildings. A future paper may quite appropriately deal in like manner with such appliances for the generating and transferring of heat as furnaces and boilers.

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IT IS a matter of extreme regret that the American Society of Heating and Ventilating Engineers did not give its approval to the Standard Code for the installation of warm-air furnaces at its recent convention. Its own committee helped frame the code and recommended its adoption. Reports from the convention indicate that the code was considered at several sessions, and aroused the warmest discussion. Some did not agree with the formula for determining the sizes of pipes, although it was presented to the joint code committee by a member of the society. Another point raised was that the code was not perfect, and the society wanted it so before it carried its endorsement. These engineers probably forgot that many of the rules and principles they are applying were not perfected at once, but were a matter of growth, experience and scientific investigation."—*From the Warm Air Heating and Sheet Metal Journal for July, 1922, published by the National Association of Sheet Metal Contractors.*

The foregoing comment refers to the proposed standard code regulating the installation of warm-air furnaces in residences, which was compiled by the representatives of four interested associations and which has received the approval of three of them, namely, the National Association of Sheet Metal Contractors, the National Warm-Air Heating and Ventilating Association and the Western Warm-Air Furnace and Supply Association. We confess to considerable sympathy with the advocates of the code, even with its admittedly insufficient requirements to make it conform to standard engineering practice. If the statement made by the chairman of the committee in charge of its compilation accurately represents the situation, the warm-air furnace industry has a long way to go before it even catches up with the present requirements of the code. There was a feeling on the part of the heating engineers in withholding their approval of the code that they could well afford to await the time when the furnace trade was prepared to adopt scientific methods in its work, and that there was no need of seeking popularity by approving a code which inadequately met the situation. We think, however, that the chairman had in mind, not so much the possible increase in the society's prestige through the adoption of the code as the service that could be rendered by the society in helping to advance the interests of the warm-air furnace method of heating.

The danger in recommitting a report of this kind, as has often been demonstrated, is that whatever enthusiasm has been kindled for the movement may die out and the whole project be placed on the shelf. If there is still the initiative on the part of the society to see the code through in an amended form, then the position taken by those opposed to its present adoption will be vindicated. On the other hand, if action by the heating engineers' society is permanently deferred and the code permitted to go out without the society's *imprimatur*, even with reservations, the heating engineering profession will have lost an opportunity which may not come again to take its proper place of leadership in the development of warm-air furnace heating.

I HAVE been directly connected with heating and ventilating work for nine years," writes one of our readers, in a letter which calls attention to a condition all too common in the industry, "all of this time except seven months with one concern. I started as tracer and blueprint boy. Today I can take the outlines or the plans of a residence, school, church, theatre, or other building and make a complete heating and ventilating plan or layout, and write the specifications, for either a mechanical warm-air furnace or one of the various steam heating systems. I have also filled the capacity of supervising the installation of the various systems. Being able to do this I feel entitled to use the term 'engineer,' for in order to accomplish the above I certainly comply with the definition given in the dictionary. Others insist I should not use this term without a college diploma. My family did not have the means of sending me to college. I learned my drafting from the I. C. S. My knowledge of heating and ventilating was gained by practical experience and by studying the I. C. S. and many other text-books on this subject. I am marking my vocation card 'engineer'; you can classify me as you wish."

There is something very appealing in this letter and, we dare say, it will strike a responsive chord with many of our readers. There is little, however, to be said, except that the letter brings out very strikingly the limited opportunities, even in the larger centers, to obtain special instruction in heating and ventilating engineering. Naturally the designation "M. E." implies a college degree. In lieu of that, one of the means we have of determining a man's status is through his membership in a recognized engineering society. It is quite customary, we know, to style oneself "engineer" or "heating engineer" after a more or less extended experience in this field, so that such a designation in itself does not mean much one way or the other.

SERVICE DEPARTMENT

Recovery of Heat from Flue Gases in Residences.

QUESTION: We are interested in heating and ventilating two-story frame residences of sixteen to eighteen rooms each, individually, not community heating, by steam, hot water or warm air, whichever would be most practical for such residences in southern Iowa.

Also the matter of having round, square or oblong steel smoke chimneys to such residences, instead of the usual brick chimney that wastes so much heat. A steel chimney would yield some heat to every room it passed through and it could be built so as to touch the junction corners of as many as four rooms in each story. It could be protected by soap-stone, gypsum rock or asbestos board where it passes through floors and where partitions touch it, and by iron grill around it in the rooms so as to prevent fires. It could enter the side of the brick chimney in the second story, so the steel chimney would not pass through the roof.

Water pipes could be placed in the chimney and connect with the radiators, all of which would tend to utilize a large portion of the heat that would usually escape through the chimney as a total loss.

Another question is in connection with the matter of a warm-air furnace for burning coal oil or crude oil as fuel, instead of coal.

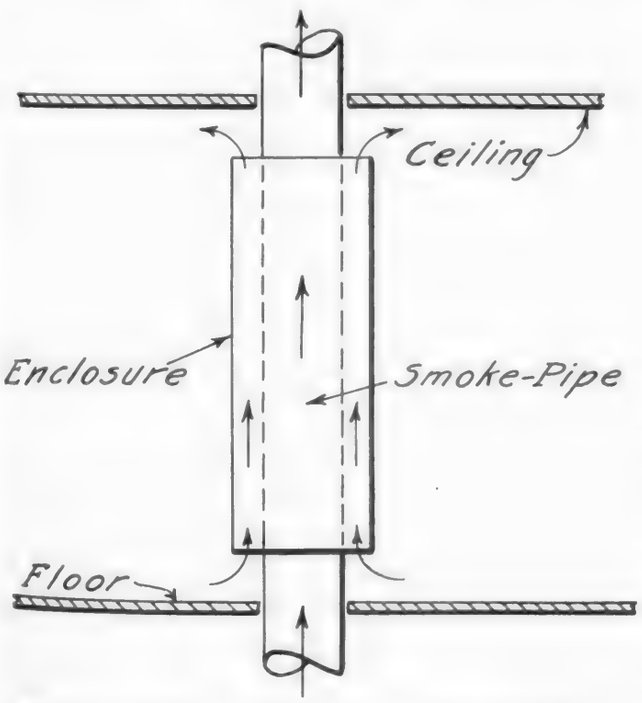

FIG. 1. SMOKEPIPE ENCLOSED FOR HEATING PURPOSES.

It is reported that heating with artificial gas will soon be an accomplished fact, but I have not yet found anything practical in reference to such a mode of heating.

I should be pleased to have reliable and practical information on all five of the above subjects.

Mount Ayr, Ia. E. C. McM.

ANSWER: More than one of our readers has doubtless run a smoke pipe the full length of some room, such as a public billiard hall and heated the room entirely from heat passing through the horizontal flue. Others may have used the scheme shown in Fig. 1, consisting merely of a pipe enclosing the smoke-pipe, but open at top and bottom, in order to establish circulation of air. The motive head produced by the difference in weight between the column of hot air inside this enclosure and colder air outside, conveys heat to the room much more effectively than could be done by the smoke-pipe alone.

In certain rural districts, farmers have long made use of a simple heating device, made up and inserted in the smoke-pipe, as shown in Fig. 2. This device, because of its numerous pipes of small size, gives a greater perimeter or square feet of heating surface per volume of flue gas than could otherwise be obtained, and this, together with the time element or retarded flow of gases,* causes considerable heat to be radiated to the room.

These arrangements suggest possibilities in connection with

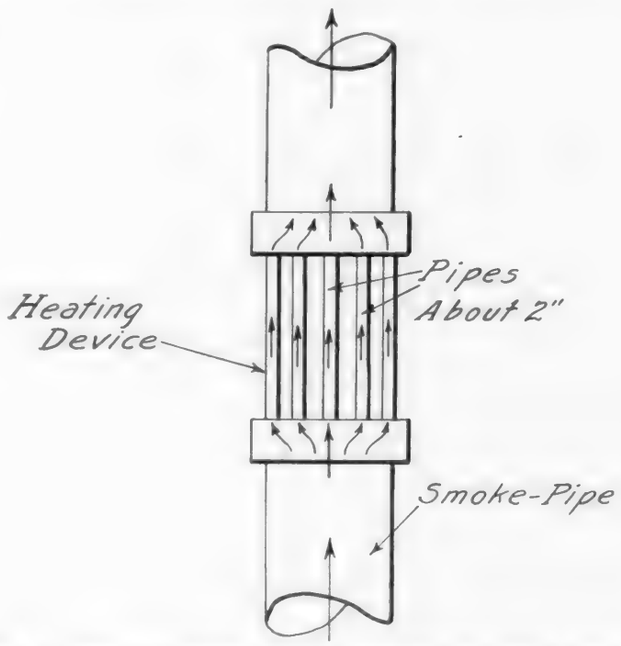

FIG. 2. SIMPLE HEATING DEVICE INSERTED IN SMOKE PIPE.

the scheme proposed in the question. This scheme, as shown in Fig. 3, is worthy of attention, and might give satisfaction if the proper conditions can be obtained, but there is nothing positive or assured about its action. Heating will be spasmodic, and, without doubt, corrosion will soon make openings in the stack. These openings, being out of sight, will increase the fire risk. The purpose of this scheme can be accomplished in better ways, and with less expense, as will be shown.

If the outer flue takes up too much heat from the flue gases, it will destroy the necessary draft, as the latter, of course, depends upon the heat and decreases with lower temperatures of flue gases. Unless this draft is far in excess of the requirements, any interference of this kind causes incomplete combustion in the fuel bed, therefore loss of heat in unconsumed gases passing up the stack.

Heat given up to the rooms might make it necessary to increase the height of stack above that as otherwise required, in order to still retain the desired intensity of draft.

Furthermore, the outer flue, of size sufficient to satisfy Underwriters' requirements, will take up valuable space within the building, so that a proportionate amount of the building cost should be debited to the scheme.

* Inasmuch as the area or volume of this device is greater than that of the stack for equal length, the volume of flue gases remaining constant, the velocity of these gases must decrease.

DIFFICULTIES IN USE OF STEEL STACKS.

A steel stack with water pipes within will collect moisture at certain times on both stack and pipes, in particular should gas be used as fuel. Stack and pipes will corrode more rapidly under these conditions, as water in combination with soot forms sulphuric acid, making it advisable to use steel plate for the stack in order to make it last a reasonable length of time. As an example of this, horizontal runs of steel flues collect moisture and oxide at the bottom, and therefore quickly rust out at this point.

When water pipes are used in flues, they are more usually placed in the horizonal runs, but regardless of their location, whenever enclosed, they are difficult to repair. Pipes and stack

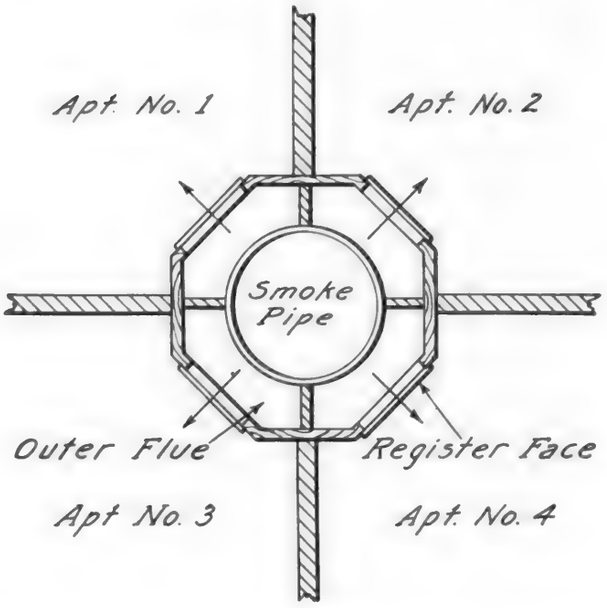

FIG. 3.—PROPOSED SCHEME FOR HEATING BUILDING FROM SMOKE STACK.

will differ in their rate of expansion and contraction, so that all pipes passing through the sides of the stack should be provided with sliding sleeves, packed to prevent air entering and destroying the draft, or sparks leaving, as might occur with down drafts. The stack, however, should be designed at the top to prevent downdrafts.

The amount of heat radiated from the stack will be small, unless it is made of some refractory material which will absorb heat and give it off as radiation, as otherwise the heat given up to the rooms is mainly that from convection currents flowing up and around the stack. It is for this reason that the enclosed flue shown in Fig. 1 gives off more heat than it would if not enclosed.

ILLUSTRATION OF LIGHTED MATCH.

Perhaps the best illustration of the above remarks, is that of a lighted match, first placed perpendicular to a piece of paper, and then held parallel and under the paper the same length of time and distance. In the first case, the paper will not char. In the second, it will, and, if the paper has its sides turned up and filled with a small amount of water, the water will boil before the match is consumed. This will serve to illustrate and explain why convection currents must be obtained for heating, instead of dependence being placed on radiation alone.

The heat from the vertical stack will cause a strong upward current in the air surrounding it, and the difference in weight, between this column of hot air and a column of cold air of corresponding height, will increase, the higher the column, so that most of the heat will go to the top floor. In that event openings from the lower floor may act as ventilators, instead of supply registers. As a consequence, louvre dampers will be required at each grille, and the opening or closing of any of these may upset the whole balance of the system. Heat given up from the stack will vary not only in accordance with the regulation of these dampers, but also with the rate of combustion, so that the required amount of heat will neither be uniform nor available at all times.

HOW SOME OF THE DIFFICULTIES MAY BE OVECOME.

To overcome difficulties of this nature, the scheme shown in Fig. 4 is proposed, top and bottom registers being used and the surrounding flue fire-stopped at each floor. In this scheme, the occupants of each apartment have sole control of the heat admitted to their own apartment, as the source of heat is independent of any other apartment. If, however, ventilation is desired in addition to heating, then the outer flue must be continuous, and passing through the basement, be opened to the outer air. Additional heat will then be required to raise the temperature of the outside air.

Referring to the grilles, possibly the intention is to design these with a high fireplace effect, but top and bottom registers as mentioned would be the best method.

There is also a type of warm-air furnace having a small stack

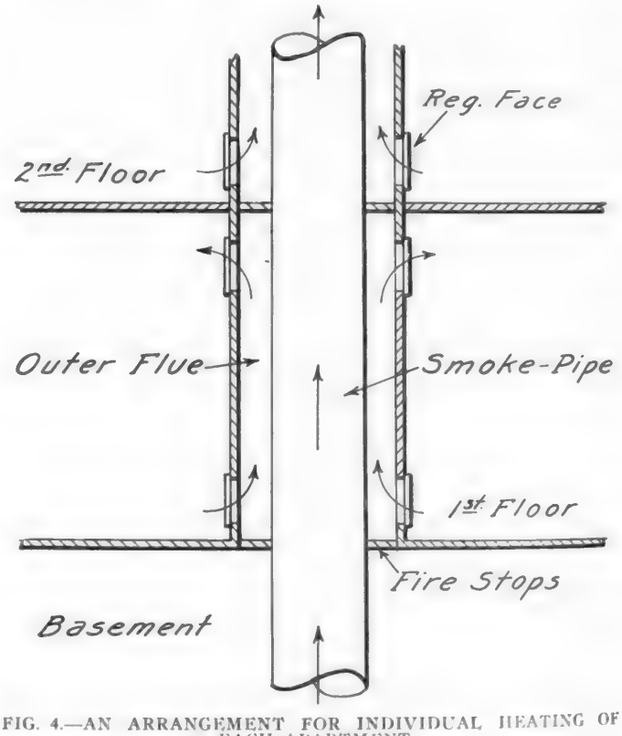

FIG. 4.—AN ARRANGEMENT FOR INDIVIDUAL HEATING OF EACH APARTMENT.

loss because of retarded flow and increased length of travel of flue gases before entering the stack. In this furnace (Fig. 5), which, incidentally, is of low height, the gases from the top pass down and through an economizer on their way to the stack. Entering cold air passes first over these preheating surfaces and is tempered before reaching the fire. A by-pass for the flue gases is also provided as an aid to the draft when starting the furnace.

THE ADVANTAGES AND DISADVANTAGES OF OIL-BURNING SYSTEMS.

As adapted to residence heating, a typical oil-burning outfit requires a storage tank* for oil,† an electric motor and blower which atomizes the oil, automatic ignition and combustion cham-

* A 55-gal. tank can be placed in the basement and a reserve storage tank of from 500 to 2500 galls. placed outside underground at a specified distance from the building and connected with the supply tank in the basement.

† Kerosene is preferred by some and has at least one advantage over oil in that it does not cake while in the storage tank.

ber where the atomized oil is burned, and a thermostat which automatically starts and stops the burner.

The short period of time required to bring any unit to its full capacity when oil is used is one of its great advantages over coal. Other advantages are more even distribution of heat, high temperature quickly reached, boilers capable of being forced to a high degree, and increased output of plant.

Stack area necessary for oil-burning plants is about 40% less than required for coal, as less free air is required to complete combustion of liquid fuel; furthermore, this air does not pass through a bed of coal, so that the resistance is less.

As compared with coal, the storage space required for oil is much less than that required for an equal weight of coal, the cost of unloading and handling is lower.

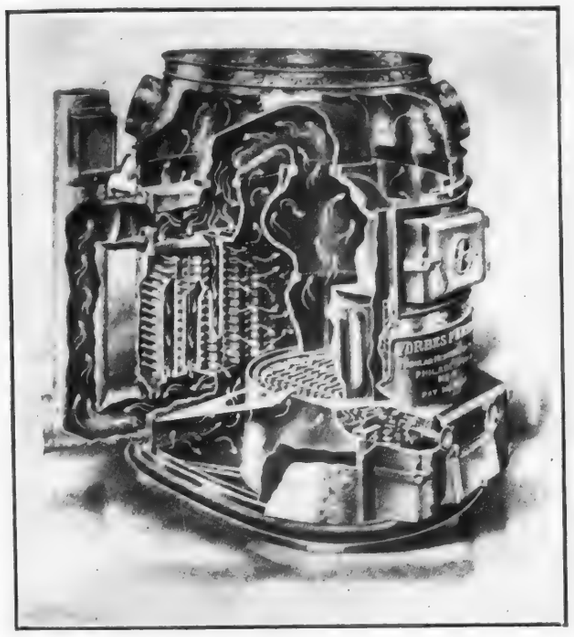

FIG. 7.—TYPE OF WARM-AIR FURNACE DESIGNED TO RECOVER WASTE HEAT FROM FLUE GASES.

MERITS OF GAS-FIRED RADIATORS.

Gas heating appliances have also been developed to a high standard of efficiency, gas steam, gas hot water, and gas hot air radiators being often used. The latter have many merits and are made either in pressed steel or cast-iron, the same as other radiators.

Among the advantages of gas-fired radiators are their low first cost of material and installation. As compared with hot air, steam, or water heating, there is no boiler, chimney, coal bin, or janitor, hence no interruption for repairs accidents or absence of janitors. Long heat distributing pipes are also eliminated, together with their heat losses, maintenance expense, and liability to steam or water damage.—T. W. REYNOLDS.

Cost of Central Heating Plants.

QUESTION: I am particularly interested in the cost of central heating plants and if you can refer me to any data it would be greatly appreciated. It seems to me that some information should be available similar to that on electric central stations showing that a complete station can be installed for $100.00 per kilowatt.

Wilkinsburg, Pa. P. A. Y.

ANSWER: It is rather difficult to name a price relative to building central station heating plants. There is a rough rule that might be used, as follows:

The cost of the power system just about equals the cost of the distribution system, and the distribution system will, as a rule, cost approximately $1.50 per foot of main per inch of diameter. In other words, a 6-in. main will cost, complete, about $9.00 per foot.

Central station heating is so different from the electrical industry that it is rather difficult to name any other rule than the above. It should be noted, in this connection, that the cost of the station proper varies materially, depending upon the style of equipment installed, the weather conditions, coal storage, etc.—BYRON T. GIFFORD.

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Cleveland's New Smoke Ordinance Permits Both Updraft and Downdraft Boilers.

Following a ruling by Smoke Inspector Filkins of Cleveland that nothing but downdraft types of boilers would be approved for certain classes of buildings, the hue and cry raised by the representatives of the updraft smokeless boiler manufacturers have now led to the passage of an ordinance known as No. 57870 A and amending section 118 of the municial code of the City of Cleveland relating to smoke abatement. It reads as follows:

"Whereas the subject matter herein constitutes an emergency by way of providing for the immediate preservation of the public health and property, and for the usual daily operation of the municipal departments; now therefore,

"Be it ordained by the council of the City of Cleveland, State of Ohio:

"Sec. 1. That Sec. 118 of the Municipal Code of the City of Cleveland, be and the same is hereby amended to read:

"Sec. 118. Where internally fired steam or hot water boilers or where hot air furnaces are to be installed for heating, the boilers, or furnace, shall be equipped with a down draft, underfeed or other type of smokeless furnace in which the combustion is completed before the products of combustion reach the flue surface of the boiler and shall be approved by the commissioner of smoke inspection, except where the boiler is to furnish heat for building containing less than 1,200 (twelve hundred) square feet of steam radiation, or less than two thousand (2,000) square feet of hot water radiation or except where, in hot air furnace installations, the total amount of grate surface in all the furnaces combined is less than 9 square feet or except where the boiler or furnace is to be installed in a building intended only as a dwelling place for less than five (5) families, except that all furnaces not so equipped shall be required to burn smokeless coal. "Smokeless coal" as used herein shall mean coal containing less than 21 per cent of volatile content and less than 1.25 per cent of sulphur content.

"Sec. 2. That Sec. 118 of the municipal code of the City of Cleveland, be and the same is hereby repealed.

"Sec. 3. That this ordinance is hereby declared to be an emergency measure and shall take effect and be in force from and after its passage and approval by the Mayor.

"Passed June 26, 1922.

"C. C. TOWNES,
"Pres. of the Council.

"F. W. Thomas, Clerk of Council.

"Approved by the acting Mayor June 29, 1922."

CORRESPONDENCE

A Challenge in Water Heating.

EDITOR HEATING AND VENTILATING MAGAZINE:

Referring to my article in your issue for November, 1921, on "What Is the Matter with Hot Water?" I note (a) a reference made by one of your leading technical firms that English methods would not find much favor in America as they would not conform to your more advanced ideas; and (b) Mr. Devendorf's reply to a question on hot water circulation in a gravity heating system, in the current issue of your journal (June, 1922).

When I read that the expansion of water in an ordinary unbroken circuit gravity heating system is one of two causes which produce circulation, I first rubbed my eyes and then carefully reread the context, as admonished previously! The expansion of the water causes a movement, but surely your contributor does not suggest that it causes a CIRCULATION—or that the force created is something which we can harness and depend upon to contribute towards maintaining a circulation? Beyond an initial movement in the direction of the expansion tank when the water is first heated, the effect of the expansion is entirely valueless for the purpose of practical circulation. The expansion force does not contribute one iota to the maintenance of circulation.

Moreover, there aren't any unbalanced forces operating in a water heating system. Nature, who, I presume it will be admitted, knows something of her own forces (despite her not being the exclusive nationale of any particular country) has a way of leveling up all the petty attempts of us puny mortals to controvert her. It is for us to study the cause and effect of her wonderful operations in a hot water plant, and apply these properly; not to stick in lip-tees, 45-in. ells, and other silly devices in a futile attempt to thwart her inexorable laws.

Poor old expansion! It is blamed for a lot of things of which it is entirely innocent. Apart from occasionally overflowing the tank because some fool rule-of-thumb man has neither the ability nor patience to figure out sufficient space to accommodate the increased volume, none of the troubles to be met with in an incorrectly designed hot water plant can justly be laid at its door. So we can cut this right out of our consideration.

This leaves only one of the alleged two fundamental causes to be kept in mind, which halves our worry and mental cogitations. But what about air locking? That, to my mind, apart from inaccurate pipe sizing, is the principal cause of defective installations. A "belly" in a small bore pipe turned upwards will often appreciably restrict and sometimes entirely retard circulation. This point is one for the erector to watch; the designer can hardly be held responsible. When a fitter reports that such and such a radiator does not heat up—knowing my pipe sizing calculations have been cross-checked—I tell him to get busy with his spirit level and not worry me! He invariably reports in due course that "It is all right now, there was air at a diminishing branch tee" or, "the fault was due to the absence of an eccentric reducer."

The amount of criticism I have received directly by mail and through the medium of your journal makes me feel that your readers are either skeptical of my assertions, or have even less knowledge of the subject than I thought. Mr. Devendorf certainly put up the best reply, and it is to him particularly that I, with your approval, would make the following offer:

Since we are both, I take it, engaged upon the practical application of the fundamental principles of heating it is up to us to design the most effective installations at the lowest cost, initial and running, compatible with safety and durability. The subject of our controversy is, at the moment, that of low-pressure water heating with gravity circulation. May I suggest, then, that it might be possible to put our knowledge of this system to a practical test? If Mr. Devendorf is agreeable, I would suggest that you submit, through the medium of your journal, typical plans and sections of an average-sized building, such as an office block with, say, twenty radiators on each of five or six floors. The required B.T.U. transmission of each radiator, also the position, type, coefficient of transmission per degree difference, available space from floor to under side of window boards, and position of boiler, to be predetermined. Then let each of us design on the same system, (i. e. low-pressure hot water, with gravity circulation) our lay-out as to sizes of radiators, pipes and valves, and submit detailed quantities to you for pricing at market rates.

Such a test, though somewhat unorthodox I know, would, I think, satisfactorily prove such points of controversy as that of my method of feeding several radiator branches from one 1-in. pipe, etc. The result, with the necessary allowances for labor, would be arrived at by your staff, and, if you wish, could be published in detail.

This, to my mind, is the only way to determine the strength and truth of our respective contentions, and should afford interest and perhaps instructions to your readers.

London, Eng. F. BROADHURST CRAIG.

Studies in Combustion of Anthracite.

At the Pittsburgh, Pa., experiment station of the Bureau of Mines, tests will be made to determine the pressure required to force air at various rates through various thicknesses of nine sizes of anthracite. The information is to be used in estimating the relative draft required to burn these sizes. C. E. Augustine, assistant engineer, has been assigned to the work.

Influence of Drafts on Body Temperature.

Experiments made in Germany on the influence of drafts on body temperature, are reported by H. H. Noyes in the *Journal of Industrial Hygiene*. The experiments were made in a large closed room. The subjects sat two minutes in front of an electrically-driven ventilator. From minute to minute thermo-electric measurements of the skin temperature were taken from the forehead, neck and chest and recorded graphically

Even in a calm the subjects differed according to age, development, and nutrition. The first cooling occurred equally quickly, with cold and warm winds, but the recovery was slower after more intense and longer cooling The velocity of the wind had an influence on the cooling A velocity of 0.6 m. per second caused in five minutes a drop in the forehead temperature of 1.5°, but a velocity of 3 to 6 m. per second only lowered it 3° to 4°. Upon interruption of the wind the skin temperature rose at once. The lowest temperature obtained and the amount of difference between it and the temperature of the wind bore no relation to the feelings of the subjects, except that a prolonged draft was followed by a feeling of discomfort and cold in the parts usually covered by clothing. Several times rhinitis, sore throat, or bronchitis was observed. In the parts usually covered by clothes the response to the stimulus of cold was slower than in the unclothed parts, owing to the difference in the vasoconstrictor muscles.

According to these experiments, drafts may cause bodily harm, because of the fact that the heat-regulatory mechanism of the body is not efficient for protection.

Testing Heating Installations.

One of the developments in the work of the Standardization Committee of the Heating and Piping Contractors National Association, in connection with the agitation for a standard code for testing heating installations, was the realization that if proper methods of figuring radiation were produced the necessity would no longer exist for such a testing code.

The same point is made by E. W. Murray, writing in *The Plumber and Journal of Heating* (London) on "Testing Heating Installations," where he says:

"From the occupier's point of view, a heating installation cannot be tested satisfactorily with thermometers, unless the building is under normal working conditions. The more satisfactory method is to survey the installation when the heat losses to be overcome are known. This can be done from the plans, provided they have been checked with the plant actually installed. For this section of the test it is not necessary for the boilers to be working. Of course, the boilers must be in operation to ascertain whether the various circuits are more or less balanced or working satisfactorily, and to arrive at the general performance of the installation as regards pipe expansion, leaks and air locks."

Speaking further on the general subject of testing heating installations, Mr. Mur-

ray states that as a rule firing periods are hardly ever given in the temperature guarantee and the question of the air changes in the rooms themselves is seldom dealt with.

These points, he adds, have a very important bearing on the heating surface installed, and he cites one installation where it was necessary for the heating boilers to be fired for a full 24 hours per day, with all windows and doors closed, in order to keep the building at the guaranteed temperature. When the boilers were banked during the night shift period, the desired temperature in the building was not obtained until about noon on the following day.

"In a large building," states Mr. Murray, "the heat cannot reach a 'steady state' until some days have elapsed. In the case of a well-known provincial building, the boilers were fired continuously night and day for some eleven days before the 'steady state' was attained. A further test on the same building, with intermittent firing, that is, the boilers banked during the night, showed that much the same time elapsed before the building reached the 'steady state,' but in this case the temperature remained at 5° F. or 6° F. lower than in the former test. This showed that the heat lost from the building to the outside atmosphere was greater than the heat given up by the heating installation. In an instance such as this, where the boilers are banked during certain periods, additional radiating surface and probably boilers would be necessary to compensate for the loss."

HINTS ON FACTORY HEATING IN CANADA

While in Canada heating systems must be sufficient to care for the coldest weather, it is not advisable to use the minimum temperature in making calculations. The low temperatures do not last more than a day or so and it requires two or three days for the average factory building to get cooled down inside. If the minimum average for three days is used, it will be found that the heating system is sufficient.

In Toronto we have had temperatures as low as 26° F. below zero but a heating system in that vicinity is usually designed for an outside temperature of zero or 5° below.

Gravity hot-water and gravity air systems are limited to smaller factories, so that for medium and large factories we have the following: First, the blower system; second, steam heating, either gravity or vacuum; and, third, forced hot water. It is possible to heat a factory by any of these systems, but each has advantages and disadvantages which make it more suitable for certain classes of buildings. We will consider them in order.

ADAPTABILITY OF BLOWER SYSTEMS.

First, the blower system. This system is particularly adaptable to large open buildings, such as boiler shops and foundries, and also to buildings where ventilation is a prime factor. In open high buildings, if a steam or water system is used, the heat tends to concentrate at the roof, even with the radiators at the floor, so that the temperature at the roof of a high building may be 25° or more hotter than at the place where the men are working. This results in high roof losses.

For this work a blower system may be placed at the ground level or in the roof trusses, and by means of ducts the heated air is carried to a point within a few feet of the ground, where it is blown towards the ground and therefore carries the heat where needed. Fans for buildings of this kind are usually fitted with means for re-circulating the air so that the fan may draw part of its air from inside of the building and part from outside, and the proportions may be adjusted from time to time to suit the requirements of ventilation and heat.

This system seems ideal for buildings where a large amount of ventilation is required. The air is usually heated to about 125° F. in the coldest weather. It may be heated by means of steam coils supplied with steam from a boiler plant, or by means of a hot-air heater, although the latter seems difficult to make. The blower system has also been used to heat factory buildings with stories not over 12 ft., but in this case these ducts usually take up a lot of room. To overcome this, the ducts have sometimes been run on the roof or under the basement, and the air carried down through hollow columns. Hot-air systems of this kind give good ventilation but are expensive to operate unless most of the air is used over again.

DOWN-FEED FAVORED FOR DIRECT RADIATION SYSTEMS.

For the ordinary factory, consisting of a building several stories high and of 12 to 20 ft. each, radiators either of cast-iron or pipe-coils are usually placed around the outside walls under the windows and supplied with steam or water. There are various methods of piping these systems. The best is the overhead supply system, where the steam or water supply main is carried to the ceiling of the top floor and runs around this, and the risers pass down through the building and feed the radiators at the top, while return risers are connected to the opposite end of the radiators and are run to the basement and connected to a return main running around the basement ceiling or floor. With this system the pipes are easily cleared of condensation, so the radiators are supplied with fairly dry steam.

The same system may be modified by carrying the steam main around the basement ceiling in place of the attic, and in this case the steam flows upward in the risers instead of downwards. For steam systems a single main may be run in the basement and a single riser to each row of radiators. In this case both steam and condensation flow in opposite directions in the same riser, so that this must be bigger. For hot-water systems, the nearest to this is the one-pipe circuit main in the basement with risers and returns run to radiators on the shunt system, or the attic supply and basement return and the one-pipe riser.

METHODS OF AIR REMOVAL.

These are the main systems, although there are many modifications. In steam systems one of the many difficulties is to get a proper system for removing the air which is heavier than steam. For this purpose, on cheaper systems, air-vents operating on the expansion principle are used and the air let out into the room. On better systems, the outlets from the air-vents are connected together and a pump or other suction device placed in the boiler-room, which draws the air to the basement where it is got rid of by an air eliminator. For better systems still it is advisable to instal a thermostatic trap on the return end of each radiator.

The returns are usually connected to a pump in the basement, which draws back the condensation and air from the system and, after getting rid of the air, forces the condensation back into the boiler. For smaller buildings, this system will work without a pump, unless the radiators are placed in peculiar positions.

REDUCING THE COST OF HOT WATER SYSTEMS.

In order to bring the cost of installation of a hot-water system to about the same level as a good-grade steam system, it is usual to place a safety-valve on the expansion tank, set at 10 to 15 lbs. This will allow the water to be carried up to about 225° F. without boiling. A pump with 25 or 30 foot head is also used, and this allows the use of very small pipe on an ordinary sized building. Under these conditions, the size of radiators will be the same as for steam system, and the pipe sizes approximately the same, although they may be made considerably smaller.

The boiler plant is practically the same size, no matter what system of heating is used. We know how much heat is required to be put into the building, if we add 15% to 20% to this for supply and return pipes, which are often placed where most of their heat is wasted, we get the amount of heat which must be put into the building.

SELECTING THE BOILER.

There are many types of boilers in use at present. If the factory has no use for exhaust or live steam, it is usual to use low-pressure boilers suitable for about 15 lbs. pressure. The cheapest boiler is the sectional cast-iron boiler. It is less efficient than a steel boiler and will not stand misuse, but if used carefully, it will no doubt outlast any steel boiler, as it is much thicker.

Of the steel boilers, there is the

standard horizontal return tubular boiler which has been used extensively. If these boilers are set with the boiler well up above the grates, they will give good satisfaction. Unfortunately, however, it is hard to get bricklayers to make a good job on boiler setting, with the result that in a year or so air leaks in around the fire and spoils the combustion. For this reason steel firebox boilers of the locomotive type have come into use during the last few years, and these have internal firebox and are also made to be put up without brick-setting so that the danger of a poor brick-setting is eliminated.

There is a new boiler of the water-tube type now being put on the market which should give good results. It is really the high-pressure water-tube boiler adapted to small low-pressure work. There are also many makes of patented boilers with many unusual features. The average efficiency of heating boilers is about 60%, and there is not so very much difference between the efficiency of cast-iron and steel boilers except in the larger sizes.

On good-sized plants it is advisable to use at least two boilers, and each of these is designed to carry about 60% of the total load, so that in severe weather it can be forced to carry almost the full load. It is not usual to use mechanical stokers on heating plants except for very large buildings.

IMPORTANCE OF SIMPLICITY.

Generally speaking, all equipment in connection with low-pressure heating systems must be made as simple as possible, as these systems are usually operated by firemen who are poorly paid and have no idea of caring for good apparatus. Even the simplest type of a pump or trap is liable to get out of order and necessitate repairs. It is for this reason that, in general, down-draft boilers with double grates for burning soft coal without smoke have not proved so efficient in use as they appear on test. The firemen change so frequently that it is very difficult to get the fireman to fire these boilers in a correct manner.

While the design of the low-pressure heating system is very simple, there are a great many put in without any regard to economy of operation, and many put in neglecting some of the fundamental principles.

CENTRAL HEATING PLANTS FOR GROUPS OF BUILDINGS.

Where we have buildings in groups to be heated, the best method is to instal a central heating plant and carry lines from this through tunnels to each of the buildings, and pipe each building as if it had a heating system of its own, except that the boilers, pumps, etc., are omitted. For large factories the boilers should be of the best grade, and automatic stokers used with coal and ash-handling systems. In these large systems it is usual to use high-pressure boilers and generate electric power, using the exhaust steam from the engines for the heating system. When a hot-water system is used, the exhaust steam is used to heat the water in a heater filled with brass tubes, through which the water is pumped, while around them the exhaust steam circulates. This condenses the steam, and at the same time, in the season, creates a slight vacuum.

There is usually an auxiliary live-steam heater installed to take care of breakdowns and to be used when there is not a sufficient supply of exhaust steam. The water is circulated by means of centrifugal pumps driven usually by steam turbines. On large systems the friction head is often as high as 100 ft., and while this requires fairly large driving units, it saves in size of piping required; and as long as the exhaust steam can be used, the reduction in pipe sizes is obtained at comparatively small cost.

ADVANTAGES OF HOT WATER FOR SCATTERED BUILDINGS.

There are several advantages of water over steam for spread-out buildings, one being that the water main may follow the contour of the ground and no drips are necessary. Another advantage is that the temperature of the water may be adjusted to suit the outside temperature, so that no valves need be touched, while a steam system must give almost constant temperature to the radiators, and therefore these must be opened or closed a number of times each day or the building becomes overheated. Where a number of buildings are to be heated from the same main, and they are situated at various distances from the power house, a differential pressure-valve is used and set so that the pressure between the supply and return to any one building will remain practically constant, regardless of changes in the pressure in the mains.—H. H. ANGUS *of Toronto before the Toronto Branch of the American Society of Mechanical Engineers.*

DETROIT ADOPTS ORDINANCE TO CONTROL RESIDENCE HEATING

In connection with a movement to provide safe operation of house heating boilers, Detroit has just adopted an ordinance which is designed to regulate the installation of heating systems in all classes of dwellings. This ordinance, which was prepared largely through the efforts of J. C. McCabe, formerly chief boiler inspector and now research engineer for the city, was finally passed on by the city council on July 6.

The average practice in most cities is to give some attention to the heating equipment in apartment buildings and perhaps large dwellings, down to 1200 sq. ft. of steam radiation. The new Detroit ordinance goes a step farther in that no limitations are placed as to the size of the equipment.

The ordinance requires that any person installing a heating system in dwellings must have a contractors' license from the Department of Buildings and Safety Engineering and as a surety that the rules will be observed, he is required to file a bond in the sum of $1,000. No installations can be made without a permit and the application blank calls for information that will give full published records of the number of rooms, general dimensions and type of construction. The published rated capacity of the various types and sizes of apparatus, whether boilers for steam or water or warm-air furnaces, must also be given to the department.

It is stipulated that the heating installation shall have a capacity to maintain a temperature of 70° F. in the main living room and a temperature of 65° F. in sleeping apartments or kitchens in which registers or radiators are placed, and that this internal temperature shall be possible of maintenance while outdoor air is at 0° F., provided a suitable chimney flue is furnished and all doors, windows and the dwellings are reasonably constructed.

Rules for the installation of the heating equipment are to be formulated by the board of rules and five representatives of contractors' installing heating equipment, these rules and regulations to become effective when approved by the common council. None of the rules is to apply to the design of systems or apparatus. In the ordinance a number of other details are included such as stipulating the periods during which inspections will be made, the charging of a maximum fee of $2.00 for each permit; the exclusion of hotels, club houses, hospitals, and other public buildings and the fine imposed for violation of the ordinance.

Department of Commerce Urges Zoning of Buildings in American Cities.

Avoidance and correction of the present topsy-turvy arrangement of so many American cities, the cause of millions of dollars' loss, is the object of "A Zoning Primer" issued by the Division of Building and Housing of the Department of Commerce, according to an official announcement today.

The enormous waste in American cities from scrapping good buildings on account of the blighting of districts has long been apparent, and for years has levied its tax on the American people.

Random crowding of stores among private dwellings, the elbowing of factories and noisy smelly garages into the rightful domains of neat retail stores or well-kept apartment houses, and the construction of tall, bulky office buildings so closely crowded that the lower floors are too dark for human use and consequently seldom occupied, is part of the present stu-

pid, wasteful jumble which proper zoning will prevent and gradually correct, in the opinion of the Advisory Committee on Zoning of the Department of Commerce.

The pamphlet describes the object of zoning, the need, the health and property protection afforded, and its effect on the cost of living. Legal problems, with an outline of what some cities have accomplished, and a zoning program are also included among other subjects. Copies are sold by the Superintendent of Documents, Government Printing Office, Washington, D. C., at five cents each.

LEGAL DECISIONS

Recovery on Quantum Meruit for Installation of Heating System.

In an action for labor and materials furnished in installing two separate heating systems for the defendant, the plaintiff alleged a special agreement for a specified price, and also sued on quantum meruit. A verdict was returned for the plaintiff for a sum slightly below that sued for. The defendant excepted.

Before the work commenced the plaintiff prepared specifications and also a written contract, but the contract was never executed. The testimony showed that the parties agreed that Pierce, Butler & Pierce down-draft boilers were to be installed as part of each system, and that the cost price for installing the two systems was $4,823, the sum sued for. The unexecuted contract contained the following clause: "This heating system, if installed in accordance with the plans and specifications, will heat building referred to herein to 70° inside temperature when outside temperature is zero." Each chimney in the houses was constructed with a flue 12x12 in. The plaintiff testified that he told the defendant's agents that the Pierce, Butler & Pierce boilers required a chimney flue 16x16 in., and that the defendant through its agents agreed to assume the risk of the flues being too small. The defendant denied that it agreed to assume this risk. The plaintiff admitted that each of the systems as installed by him failed to produce a proper circulation of steam, and that coal would not burn freely under the boilers. The plaintiff contended, however, that the unsatisfactory results were not due to any fault in the systems, but to lack of draft resulting from the construction by the defendant of inadequate flues, and the use of each chimney in connection with a separate system for heating water. The defendant introduced testimony that the lateral steam pipes did not pitch sufficiently toward the boiler and that the radiation was insufficient. Before suit was commenced the defendant ordered the plaintiff to remove the two boilers. On its refusal, the defendant substituted other boilers of a different type and stored those first installed.

On appeal, the Rhode Island Supreme Court, Lawton v. Newport Industrial Co., 115 Atl. 645, found that the primary issue to be considered in the case was: First, whether the failure of the systems to function was due to the chimney flues being of insufficient size; and, second, if the flues were too small, did the defendant agree to assume the risk of flues 12x12 in. being inadequate? There was testimony which, the Supreme Court thought, warranted the jury in finding both of these issues in favor of the plaintiff.

To the defendant's contention that the plaintiff could not recover if he had failed to complete his contract the court said that the declaration contained a quantum meruit count. The testimony showed that the defendant intended to retain and was using all of the two systems excepting the boilers, and there was no contention that it would cost the defendant any sum even approximating the contract price to make the alterations, including new boilers and extra radiation which the defendant contended were necessary to produce the systems which the plaintiff agreed to furnish and install. The defendant decided to retain and was enjoying the benefits of labor and materials, furnished by the plaintiff, of a value clearly in excess of any damage which the defendant suggested by evidence that it had suffered by reason of the alleged breach of contract. It was not suggested that the plaintiff did not in good faith endeavor strictly to perform the contract. Under the circumstances it was held that the defendant was not entitled to be enriched at the expense of the plaintiff, even although the plaintiff broke his contract. Defendants' exceptions were overruled and judgment directed for plaintiff on the verdict.

Paper Test of Safety of Pipe Held Admissible in Evidence.

In an action against the installers of a heating plant for damages for loss of a house by fire, alleged to have been caused by the defendants' negligence in placing the end of the smoke-pipe where it entered the chimney so near the woodwork of the house, the sill, and the hearth box that the latter caught fire from the heat of the pipe, the defendants contended that the installation was properly completed and that the fire originated from some other cause. From a verdict and judgment for the defendants the plaintiff appealed. One of the grounds of appeal was the alleged erroneous admission of the testimony of two witnesses who testified to a paper test they had made to ascertain whether the heat of the pipe would be sufficient to ignite inflammable material at a point about 11 ft. from the furnace. The contention of the plaintiff was that the pipe set fire to a wooden sill about 4 in. from the end of the pipe at the point where it entered the chimney. The testimony of the witnesses was to the effect that they made the paper test upon a furnace larger than the plaintiff's, the paper being tied on the pipe and left there 3½ hours with the register red hot, and that it did not ignite. The South Carolina Supreme Court, Adams v. Wilkes, 109 S. E. 804, holds that this testimony was clearly admissible. Judgment for the defendants was affirmed.

Construction of Heating and Ventilating Contractor's Surety Bond.

The bond given by a heating contractor to a school district of Missouri obligated the surety to "repay the said school district all sums of money which they may pay to other persons on account of work and labor done or materials furnished on or for said buildings." The contractor became bankrupt and failed to pay subcontractors for materials used in the heating and ventilating system of the buildings. The subcontractors sued the directors of the school district for damages for their failure to require the contractor to execute a bond to the district conditioned for the payment of all material used in such work as required by the Missouri statute. They obtained judgment (194 Mo. App. 194; 196 Mo. App. 459) and the district directors paid their claims and sued the surety on the bond. It is held, School Dist. No. 37 v. Aetna Accident & Liability Co., 234, S. W. 1017, that the surety was liable to the district for amounts paid by the latter for materials, ordered by the contractor and used in the installation of the heating and ventilating system, although neither the contract therefore nor the contractor's bond obligated the contractor or surety to pay for such material.

Organization of American Construction Council.

Following the organization meeting in Washington of the American Construction council, the first meeting of the executive board was held in New York, June 23 and 24, at the home of Franklin D. Roosevelt, president of the council. At this meeting a definite program was agreed upon, one of the principal items being an attempt to overcome the lack of steady employment. Efforts will be made to have those engaged in large construction operations lengthen the construction season and to determine the kinds of work that can successfully be done in winter. In this connection statistics will be collected regarding the labor supply in an effort to adjust the volume of work to the labor supply in various localities. At the same time it is proposed to carry on a publicity campaign showing the advantages of a better distribution throughout the year of new construction and repair work.

Vocational guidance and the establishment of apprenticeship systems are also included in the program as laid out. Still another item is the establishment of codes of ethics and standards of procedure.

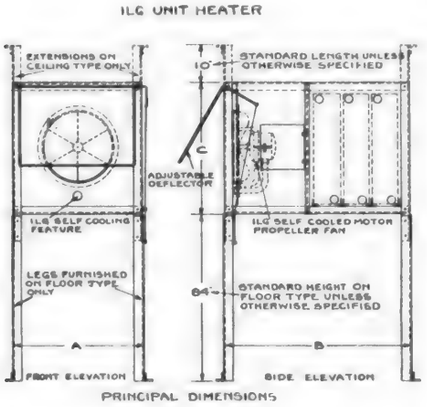
The executive board as elected consists of 44 members representing eleven major groups. The representatives of the engineers' group are Charles T. Main, Boston; Bion J. Arnold, Chicago; Peter Junkersfeld, New York; Charles L. Loweth, Chicago.

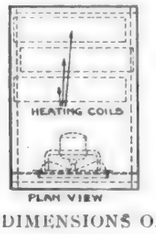
PORTABLE UNIT FAN BLAST HEATERS

2—The Ilgair Unit Heater.

A unit heater which possesses considerable flexibility in connection with its application has been developed by the Ilg Electric Ventilating Co., Chicago, Ill., and is marketed under the name of the Ilgair unit heater. Each unit constitues a separate heater and both the volume and distribution of the heat is controlled at its source. As the manufacturers point out, it is an easy matter to rearrange the placing of any one or more units while if a building in which the heaters are installed is remodeled or enlarged the additional heating needs may be taken care of by replacing or installing additional units.

As will be seen from Fig. 1, the Ilgair unit heater is a cabinet, open at both ends, in which is housed two or three stacks of Vento heaters, together with an Ilg self-cooled motor propeller fan. The cabinet serves as a heating chamber for the air





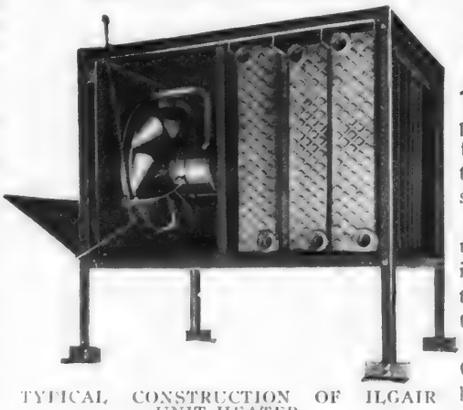
SIZE	A	B	C
3000CFM	35⅛	65⅛	46⅛
5000CFM	52⅛	70⅛	46⅛
7000CFM	66⅛	74⅛	58⅛
10000CFM	73⅛	78⅛	58⅛

DIMENSIONS OF ILGAIR UNIT HEATERS.

which is drawn in over the heated coils on the intake side at low velocity, about 1500 ft. per minute and discharged in volume at high velocity, about 2500 ft. per minute.

The cabinet is equipped with a movable deflector to control the placement of the air By this means the heated air may be delivered in the desired direction. If this is at the breathing line, as the air warms up, the deflector can be raised allowing the current of air to straighten out to a point 50 or 60 ft. away. The velocity has been made low enough so as to prevent drafts or circulation of dust on the floor, this having been found an important consideration in the installation of such units in industrial plants.

The Ilgair unit heater is furnished in two different types—a pedestal model for floor installation, and a type for ceiling suspension. The only difference is in the mounting. When the ceilings are rather low the manufacturers recommend the ceiling type. The pedestal model, however, makes a more flexible system be-



TYPICAL CONSTRUCTION OF ILGAIR UNIT HEATER.

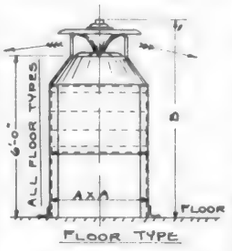
cause it is portable. As a rule the floor-type heater does not obstruct the floor space as there is room beneath it for the storage of material, or, if desired, the pedestal can be furnished with shelves for tools, etc. Either floor type or ceiling type can be furnished with or without stationary diffuser.

DATA ON ILGAIR UNIT HEATERS.

Size cu. feet per min.	Sq. ft. Radiation 2 Stack	3 Stack	Power Imput Watts	Comp'te Wt. in Lbs. 2 Stack	3 Stack
3,000	128	182	300	1,750	2,325
5,000	194	291	450	2,600	3,475
7,000	270	405	625	3,450	4,650
10,000	351	526	900	4,100	5,675

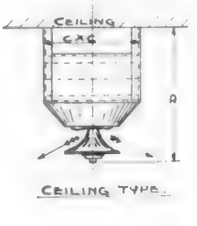
In dealing with the capacity of these units it is stated that the number required is dependent on the floor area and not on the height of ceilings. This is attributed to the adjustable deflector which holds the circulation of air at or near the floor. Circulation, therefore, takes place at the breathing line only—from the floor level to a height of about 7 ft. This feature, on which much stress is laid by the manufacturer, is stated to be covered by a basic patent. It is figured that an average building 166 ft. long and 60 ft. wide, with

~ Dimensions and Engineering Data. ~
Wing "Scruplex Unit Heater.



GENERAL DIMENSIONS. SIZE.	A x A	B.	C x C.	D
FC-17-2-12	33"	7'-6"	33"	60"
" -17-3-12	33"	7'-6"	33"	70"
" -22-2-12	44"	7'-9"	44"	64"
" -22-3-12	44"	7'-9"	44"	74"
" -25-2-12	54"	8'-0"	54"	72"
" -25-3-12	54"	8'-0"	54"	82"
" -25-3-18	54"	8'-0"	54"	72"
" -25-4-18	54"	8'-0"	54"	82"
◇ SC-17-2-12			44"	51"
◇ " -17-3-12			44"	58½"
◇ " -22-2-12			54"	57"
◇ " -22-3-12			54"	64½"

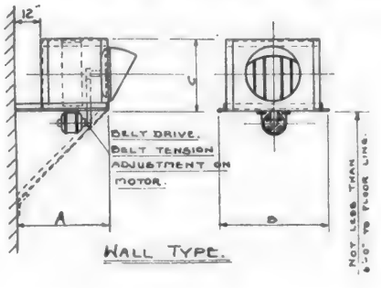
◇ = Special low-head ceiling type.



ALL STANDARD CURRENT. ~ ENGINEERING DATA ~ STEAM 5LBS - AIR 60°F.

SIZE UNIT.	C.F. AIR PER MIN.	DIAM. WHEEL	SPEED R.P.M.	H.P. MOTOR	NUMBER SECTION SIZE	SQ. FT. VENTO.	FINAL TEMP.	B.T.U. PER HOUR	STEAM LBS.-HOUR	EQUIVALENT TO DIRECT RADIATION C.I.	EQUIVALENT TO DIRECT RADIATION N.I. PIPE	APPROX. WGT
FC-17-2-12	2000	17"	1150	¼	2	96	110°F	95000	106	400	320	1350
" -17-3-12	2000	17"	1150	¼	3	144	127 "	125000	144	510	410	1750
" -22-2-12	3500	22"	1150	½	2	172	110 "	175000	189	720	576	2100
" -22-3-12	3500	22"	1150	½	3	258	127 "	225000	258	940	750	2800
" -25-2-12	5400	25"	1150	½	2	270	110 "	270000	297	1115	890	3050
" -25-3-12	5400	25"	1150	½	3	405	127 "	350000	405	1450	1160	4150
" -25-3-18	7700	25"	1750	1½	3	405	120 "	450000	518	1875	1500	4250
" -25-4-18	7700	25"	1750	1½	4	540	134 "	550000	643	2285	1830	5350
SC-17-2-12	2500	17"	1150	¼	2	120	105°F	110000	112	446	357	1500
" -17-3-12	2500	17"	1150	¼	3	180	117 "	140000	136	574	462	2000
" -22-2-12	4000	22"	1150	½	2	190	103 "	165000	176	691	553	1650
" -22-3-12	4000	22"	1150	½	3	285	117 "	215000	231	896	717	2050
W-15-2-12	1500	15"	1150	⅛	2	72	110°F	75000	88	310	250	1050
" -15-2-18	2000	15"	1750	¼	2	88	110 "	100000	107	417	333	1200
" -17-2-12	2500	17"	1150	¼	2	120	110 "	125000	146	520	417	1600
" -22-2-12	3000	22"	1150	¼	2	132	110 "	150000	186	625	500	2000
" -22-3-15	4000	22"	1500	½	3	172.5	110 "	200000	224	833	667	2200
" -28-3-12	5000	25"	1150	½	3	217.5	110 "	250000	283	1040	833	2700

NOTES: "FC"= STD. FLOOR OR CEILING TYPES. - "SC"=SPECIAL LOW CEILING TYPE - "W"= WALL TYPE.



GENERAL DIMENSIONS. SIZE.	A.	B.	C.
W-15-2-12	3'-6"	2'-0"	2'-8"
" -15-2-18	3'-6"	2'-5"	2'-8"
" -17-2-12	3'-6"	3'-2"	2'-8"
" -22-2-12	3'-6"	4'-0"	2'-8"
" -22-3-15	3'-10"	5'-3"	3'-6"
" -25-3-12	3'-10"	4'-0	3'-6"

about 10,000 sq. ft. of floor space, can be satisfactorily heated with five unit heaters handling 15,000 cu. ft. of air per minute and using not over 2 H. P.

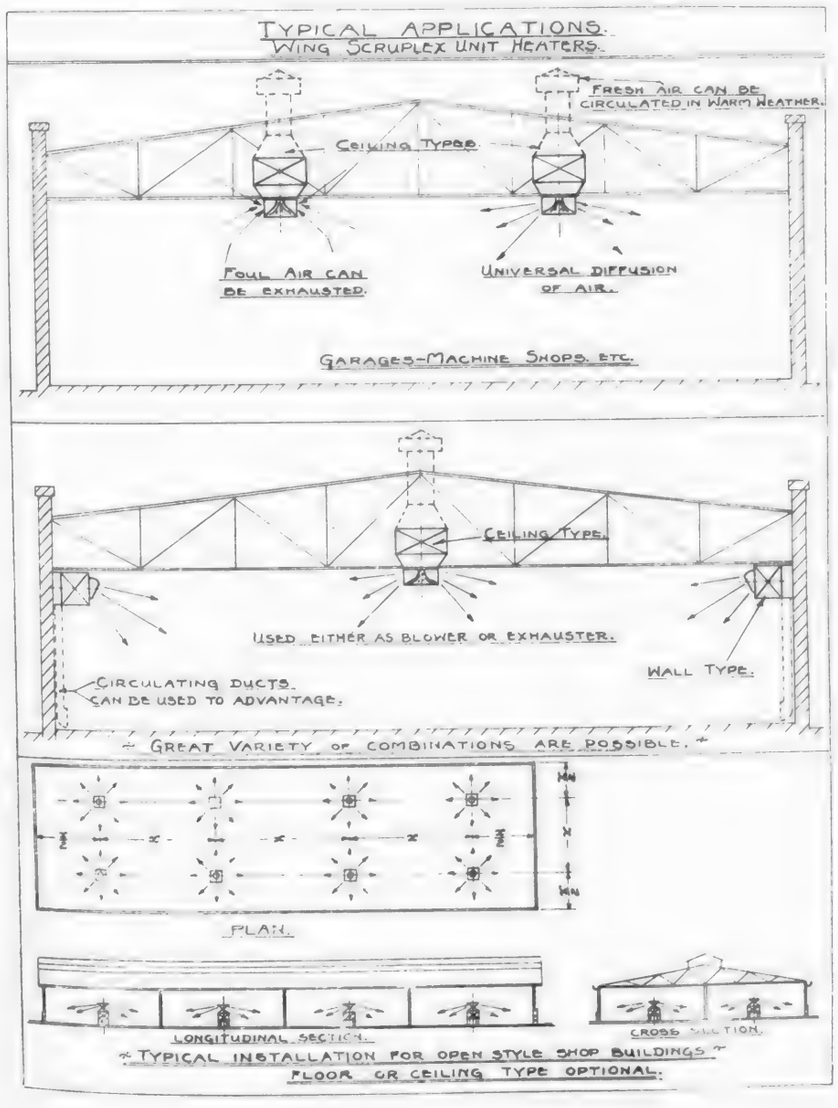
One of the first demonstrations of the Ilgair unit heater to attract general attention was the installation in the Eagle Submarine Chaser plant, built in Detroit during the war. This was an all-glass building, 1800 ft. long, 350 ft. wide and 55 ft. high. Sixty size 36 Ilgair unit heaters were used to heat this building, requiring a total of 60 H. P.

3—Wing-Scruplex Unit Heaters.

In the design of the Wing-Scruplex heater, made by the L. J. Wing Mfg. Co., New York, the motor is placed entirely outside of the path of the warm air handled by the fan. It is located at the top of the apparatus just above the circular diffusing nozzle, with the fan directly connected to it just below the diffuser. The circular diffuser has a tendency to deflect the heated air horizontally downward and thus effect a complete circulation in repeated cycles. It will be evident that such an arrangement tends to warm the air at the floor line first and the circulation is maintained at the lower level where the workers are usually located.

Each heater is equipped with a Wing-Scruplex fan, which is of the screw propeller type, while the heating element is extended surface radiation. One of the advantages mentioned for these units is that they may be installed so as to be used according to season, either as a heater, or for fresh air supply or for foul air exhaust. It is also possible to run cold water or refrigerant through the coils to produce cooling effect in summer. While these heaters are made in standard designs, special units are obtainable to meet any unusual conditions.

THE WING-SCRUPLEX UNIT HEATER.


TYPICAL APPLICATIONS.
WING SCRUPLEX UNIT HEATERS.
FRESH AIR CAN BE CIRCULATED IN WARM WEATHER.
CEILING TYPES.
FOUL AIR CAN BE EXHAUSTED.
UNIVERSAL DIFFUSION OF AIR.
GARAGES-MACHINE SHOPS, ETC.
CEILING TYPE.
USED EITHER AS BLOWER OR EXHAUSTER.
WALL TYPE.
CIRCULATING DUCTS CAN BE USED TO ADVANTAGE.
GREAT VARIETY OF COMBINATIONS ARE POSSIBLE.
PLAN.
LONGITUDINAL SECTION.
CROSS SECTION.
TYPICAL INSTALLATION FOR OPEN STYLE SHOP BUILDINGS
FLOOR OR CEILING TYPE OPTIONAL.

American Engineering Council on Registration of Engineers.

Endorsement of the idea of registering certain classes of engineers, especially those engaged on the construction of public works, is given in a report of a special committee of the American Engineering Council of the Federated American Engineering Societies which has been adopted by the executive board of the council. At the same time the report states that the committee is unable to agree on the matter of registering engineers engaged in other classes of work. Following is the full text of the report:

"In considering matters of government as affecting the engineering profession of the United States, the ancient principle which states 'that country is governed best which is governed least,' has been accepted by your committee as representing ideal conditions, and it holds that in an ideal social organization, where man can be left free to follow the trend of his individual bent without resulting injury to his fellow, each should be free to follow such calling as he may adopt, without state interference or regulation.

"Engineering in the United States under absolutely untrammeled conditions in the past has developed effective skill and a high degree of constructive ability among its practitioners, during which period the provisions for safety have been adequate under average conditions, and the failures which may have occurred have not been rated serious enough to demand legal control. Within the past few years, however, a widely supported movement had appeared, resulting in the passage of laws, requiring licensing or registration of engineers in various states, and attempts at similar legislation in others.

"It is, therefore, a condition and not a theory which is before the engineering profession for consideration, and the F. A. E. S. should decide whether it will lend the weight of its advice upon principle only or will accept and travel with tendencies.

"The registration or licensing of engineers with consequent elimination from practice of all not registered, can be supported only upon two grounds; (a) the benefit to the profession; (b) the good of the public. Your committee has grave doubts whether licensing can benefit the profession enough to justify the cost and annoyance of the proposed measure. Further, your committee holds it should be beneath the dignity of engineers to fence themselves against qualified competition by the artificial barrier of a statute.

"Your committee, while recognizing that required registration might not have been recommended ab initio believe that the plan has now reached such development as to deserve consideration and possible direction by the F. A. E. S. (or A. E. C.).

"(a) Your committee recommends to

the A. E. C. (F. A. E. S.) an expression of opinion that such legislation may properly cover engineers and architects charged with responsibility for public works.

"(b) Your committee is agreed that the reasons which justify the registration of engineers responsible for public works do not apply to mining engineers.

"(c) Your committee is unable to agree as to the wisdom or unwisdom of registration of engineers engaged in other classes of work.

"(d) Registration laws should provide reciprocity of registration admitting to practice engineers registered in other states and should further provide for the admission to practice of properly accredited engineers from states having no registration laws.

"(e) Registration laws should provide for classified registration, that the certificate may indicate those branches of engineering in which the registrant is qualified to practice."

NATIONAL TRADE EXTENSION BUREAU

Movement For Uniformity In Trade Terms

A much-needed action has been taken by the National Trade Extension Bureau, through a special committee, in suggesting proper titles and definitions of the various branches of the heating and plumbing industries. The term "steam and hot water fitter," for instance, came in for discussion and the opinion was expressed that this term unquestionably fits the mechanic better than the proprietor of an establishment. It was also brought out that the term "heating dealer" would be equally appropriate to one engaged in the heating business, but the representatives of the Heating and Piping Contractors' National Association are of the belief that there should be an outstanding distinction between these two classes of business men. They therefore recommended that one engaged in the heating business should be known and advertised as a "heating contractor."

Because there seems to be a universal opinion that a person or firm engaged in the heating business prefers to contract for heating installations; and because the public usually demands a contract on a heating installation including a guarantee; and further because there is a desire to have heating and plumbing more pronouncedly classified; the name *"heating contractor"* has been adopted for the name of a person or firm engaged in the sale and installation of heating materials and appliances.

The definition as prepared by the committee for a *"heating contractor"* is as follows:

DEFINITION OF A HEATING CONTRACTOR.

A *heating contractor* shall be defined as a person, firm or corporation, regularly engaged in business and equipped to render heating services to the public, and who not only buys, stocks and sells at retail, but, also, installs and contracts to furnish and install heating appliances, fixtures, accessories, and other materials used in heating installations.

Where a person or firm conducts both a heating and plumbing business, such person or firm shall be known as a *"plumbing dealer and heating contractor."*

The name "domestic engineer," it was felt does not apply to the industry as a whole, and the name "heating and ventilating engineer" might better apply to an employee in the office of an architect or other building construction office; and does not essentially designate a firm contracting for and installing heating plants and equipment. The names "sanitary engineer," and "heating engineeer," were placed in the same category as "domestic engineer" and "heating and ventilating engineer,' and cannot be construed to necessarily refer to those engaged in the heating and plumbing business.

THE PLUMBING DEALER

The committee believes that a firm engaged in the plumbing business should be known as a *"plumbing dealer"*; because the word "dealer," is generally understood by the public as representing a person or firm engaged in a definite line of retail business, operating a place where a particular line of merchandise, commodities, or service can be seen and purchased.

By standardizing on this name, it will be a simple matter to soon educate the public to know that the place to buy plumbing goods is at a *plumbing dealer's* establishment.

The term "master plumber or steamfitter," it was maintained in no way presents the idea of a man or firm being *engaged in the sale* of plumbing or heating materials. A "master plumber or steamfitter," according to Mr. Webster, might better be applied to the foreman, or superintendent of an establishment.

"Plumbing contractor," in the opinion of the committee, is a term that is just as easily misunderstood. It is only natural for one, not familiar with the industry, to interpret it that such a firm or person contracts for plumbing installations, and that they do so without regard to where the material is purchased.

A "jobbing plumber," or a "jobbing steamfitter,' are terms that are not clearly understood by the public, and are therefore misleading.

The name "merchant plumber or merchant fitter," continues the report, was coined with the idea of placing the owner of a plumbing or heating establishment on the same place as a "merchant tailor" The public, however, has not recognized the connection.

The name *"plumbing dealer"* signifies everything that one would wish to convey or sell to the public. To be a *"plumbing dealer,"* one must be equipped to render all the service that the public demands of those from whom they would buy plumbing.

The term *"dealer"* when applied to the plumbing business is much more desirable the committee thinks, than the word "contractor," for it fits the methods of a greater number of the firms engaged in this business. Today, the average firms engaged in the plumbing business, are attempting to build and operate their business through salesmanship. They find it more profitable to sell material and services, in preference to bidding for work specified by others. This is not so true of heating, where the principal point of salesmanship is largely that of selling the ability of the engineering force of the heating firm.

The definition of a *plumbing dealer*, as adopted by the committee, is as follows:

DEFINITION OF A PLUMBING DEALER.

Any person, firm or corporation equiped to render plumbing services to the public, and who buys, stocks, sells at retail, installs and contracts to furnish and install, plumbing appliances, fixtures, accessories, or other materials used in plumbing installations, shall be defined as a *plumbing dealer.*

To further classify the industry, the committee recommends that the word "jobber" be dropped from the vocabulary of the heating and plumbing industries, with the exception of where it applies to a journeyman who does repair work. He should be known as a jobber. For one engaged in the wholesale business, the term *"wholesaler"* shall apply and the definition of a *"wholesaler"* shall be as follows:

DEFINITION OF A WHOLESALER.

Any person, firm or corporation engaged in the buying, and stocking of fixtures, appliances, accessories or other materials, in quantities, for the purpose of rendering a distribution service to dealers or institutions, and who do not sell at retail or engage directly or indirectly in contracting, shall be defined as a *wholesaler.*

MANUFACTURER.

The committee further recommends, that all firms in the retail business shall eliminate the words, "wholesaler or jobber" from their stationery and literature: and further recommend that all jobbers who are not actually engaged in the manufacturing business should take steps to eliminate the word *"manufacturer"* from their stationery and literature, or where used in connection with the firms' names.

The committee recommends the following definition for a manufacturer:

DEFINITION OF A MANUFACTURER.

Any person, firm, or corporation, engaged in the making or the assembling of an article or wares, for sale or distribution through the customary and regular channels of trade, shall be defined as a *manufacturer.*

O. W. Armspach, of the Research Laboratory of the American Society of Heating and Ventilating Engineers, has resigned to become associated with the E. Vernon Hill Company, aerologists, of Chicago. Mr. Armspach was formerly associated with Dr. Hill in the ventilation division of the Chicago Board of Health.

PRACTICE ENDORSED OF CONNECTING RETURNS AT WATER LEVEL OF BOILER.

A suggestion that the returns to steam heating boilers be connected at the water level, which was made two years ago by the National Boiler and Radiator Manufacturers' Association, in conjunction with the Steam Boiler and Flywheel Service Bureau of the Hartford Steam Boiler Inspection and Insurance Company, has now been endorsed by the Engineers' Conference of the Steam Boiler and Flywheel Service Bureau, thus confirming the original estimate of the value of this method.

As described at the time in THE HEATING AND VENTILATING MAGAZINE (June, 1920) the recommended practice is designed to maintain a proper water level in the boiler and in that way prevent the cracking of the sections.

As the bureau states in its report, systems are often encountered of such proportions and arrangement that the requirements for proper operation are not met when first starting with a cold system. Later, when the volume of steam demanded is less and therefore the pressure differences required are less, the proper working conditions may be maintained. In such cases a check valve installed in the return line near the boiler may make the installation workable.

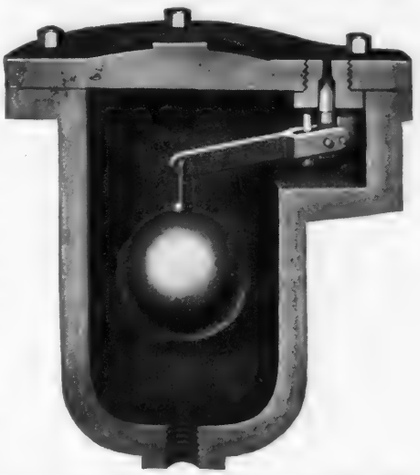
The use of check valves on a low-pressure steam heating system in the case of two or more boilers is not as satisfactory an arrangement as in the case of a single boiler. If a check valve is applied to the individual return pipe to each boiler, there is a tendency to disturb the uniformity in water levels in the boilers, since it is impracticable to have the different check valves work in unison If a single check valve in the return main is applied, then a surging of water between the boilers is likely to occur with variations in the rate of evaporation in the boilers. Also, with this class of return connection, if, through error or otherwise, the steam stop valve from one boiler should be closed before the water return valve, while the boiler is steaming, the water would be driven from this boiler over to the others, resulting in overheating or cracking the parts.

It is evident that if the return connection to a boiler should be located at the normal water level instead of near the bottom of the boiler, as is now customary, it would be impossible to force water out of the boiler through the return pipe below the point where the connection was made to the boiler. Therefore, if the return connections were made as described, check valves on the return lines would not be required to maintain a safe water level in the boiler. While the water in a single boiler might tend to flow back into the return pipe, or in the case of two or more boilers the water might tend to surge from one boiler to another with connections as described, this action would automatically cease when the water level reached the point where the return connection was made.

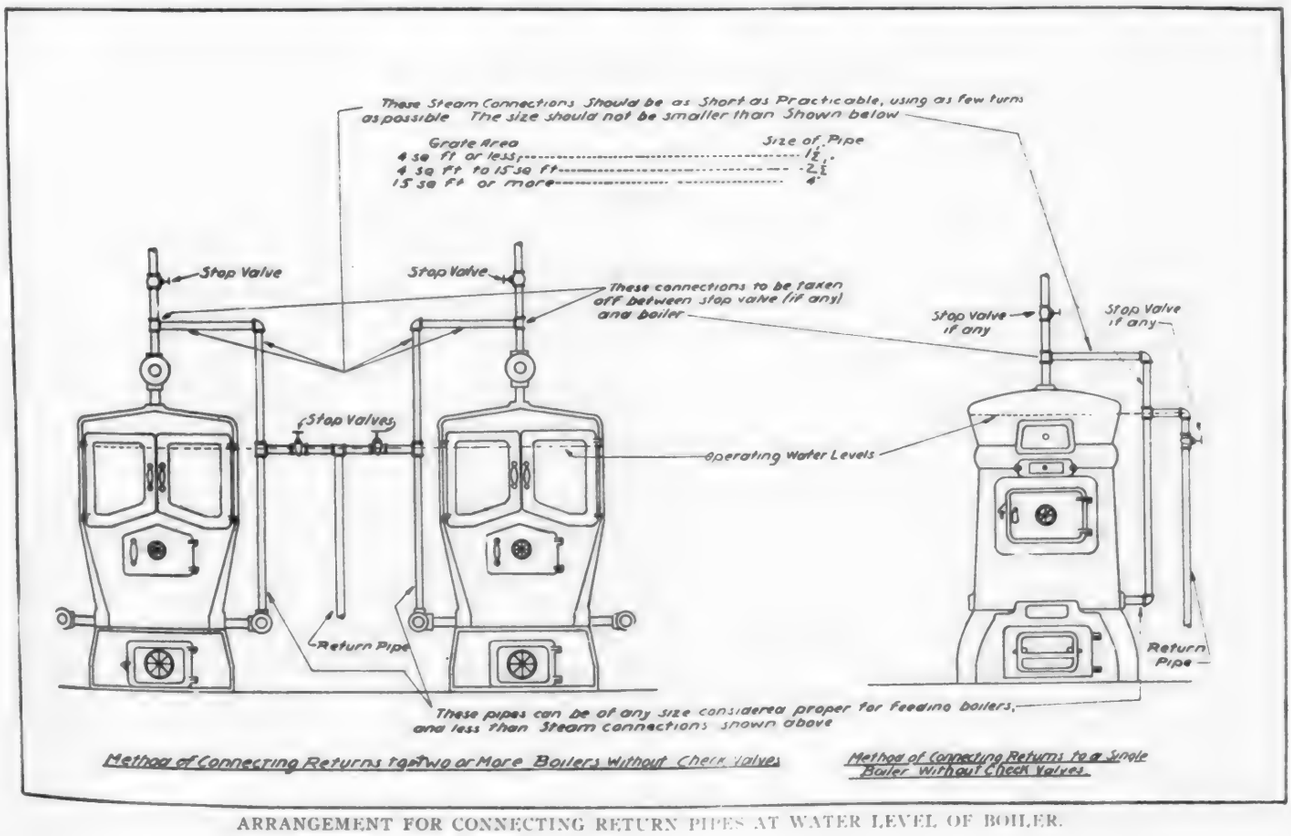
If a pipe connects the steam space of a boiler with the point where the return connection is usually made, in effect this pipe becomes a part of the boiler the same as adding a section to a sectional boiler. The return connections can be attached to this pipe at a height corresponding to the safe working water level in the boiler and thereby secure the same result as would be obtained by delivering the water directly to the boiler at the water line, although it is actually introduced at the usual bottom connection.

How and Where to Use Automatic Air Traps.

In connection with the recent discussion in these columns of automatic air traps suitable for heating coils in forced water heating systems, a device shown herewith and known as the Wright-Austin air trap accomplishes this purpose very effectively and obviates the need of using steam traps turned upside down.



AIR TRAP SUITABLE FOR USE IN CONNECTION WITH FORCED HOT WATER SYSTEMS.


These Steam Connections Should be as Short as Practicable, using as few turns as possible The size should not be smaller than Shown below
Grate Area
Size of Pipe
4 sq ft or less
1½"
4 sq ft to 15 sq ft
2½"
15 sq ft or more
4"
Stop Valve
Stop Valve
These connections to be taken off between stop valve (if any) and boiler
Stop Valve if any
Stop Valve if any
Stop Valves
Operating Water Levels
Return Pipe
Return Pipe
These pipes can be of any size considered proper for feeding boilers, and less than Steam connections shown above
Method of Connecting Returns to Two or More Boilers Without Check Valves
Method of Connecting Returns to a Single Boiler Without Check Valves

ARRANGEMENT FOR CONNECTING RETURN PIPES AT WATER LEVEL OF BOILER.

This type of trap is designed to remove air from water under any pressure up to 150 lbs. It may also be used on closed water tanks and receivers, water supply lines, centrifugal pumps, and the like. A whistle may be attached to the trap for the purpose of sounding an alarm when the water reaches a certain level in a tank or receiver.

NEW BOOKS

The A. S. H. & V. E. Guide.

Bearing many evidences of the painstaking care with which it was compiled, the initial number of the American Society of Heating and Ventilating Engineers Guide for 1922 has just been published. It is a volume of 360 pages, 6x9 in. While some of the plans for this work did not develop to a sufficient extent to be embodied in this first issue, nevertheless the book cannot fail to impress those who receive it as a notable publication and one that opens up great possibilities for future editions. While many will consider the reference data section as the most important and valuable feature of the Guide, we believe an even stronger appeal lies in the catalogue data section. Here, for the first time, the products of the manufacturers of heating and ventilating apparatus are presented in a form that cannot fail to appeal to both engineers and contractors who are looking for facts, rather than general claims.

The first section of 100 pages is given over to the standards adopted by the society, committee reports and technical papers on a number of heating and venting subjects. The general data section includes the direct radiation tables based on the experiments of the late Director John R. Allen and F. B. Rowley. There are also important data on air conditioning. In all nearly 100 pages are devoted to the general data section, but it may be expected that this section will be considerably augmented in later editions to make the date more comprehensive. Other sections take up examples of modern engineering and equipment and the beginning is made of a directory of heating and ventilating consulting engineers. Each department is carefully cross-indexed.

While the society's Guide Publication Committee is deserving of full credit for the successful outcome of its efforts, much of this credit properly belongs to J. E. Bolling, secretary of the committee, whose efforts were apparent at all stages of the work and are reflected throughout the pages of the Guide.

The Guide is bound in cloth and may be obtained from the American Society of Heating and Ventilating Engineers, 29 West 39th Street, New York, or through the book department of THE HEATING AND VENTILATING MAGAZINE. Price $3.00.

MODERN PLUMBING ILLUSTRATED, by R. M. Starbuck, has made its appearance in a fourth revised and enlarged edition. It now contains 407 pages, illustrated by some 70 detailed drawings. It is presented as an up-to-date and practical work on modern plumbing practice. Size 7¼x 10½ in. Price $5.00. Published by the Norman W. Henley Publishing Co., New York, or may be had through the book department of THE HEATING AND VENTILATING MAGAZINE.

New Apparatus and Appliances

Carrier Low-Pressure Refrigerating Machine.

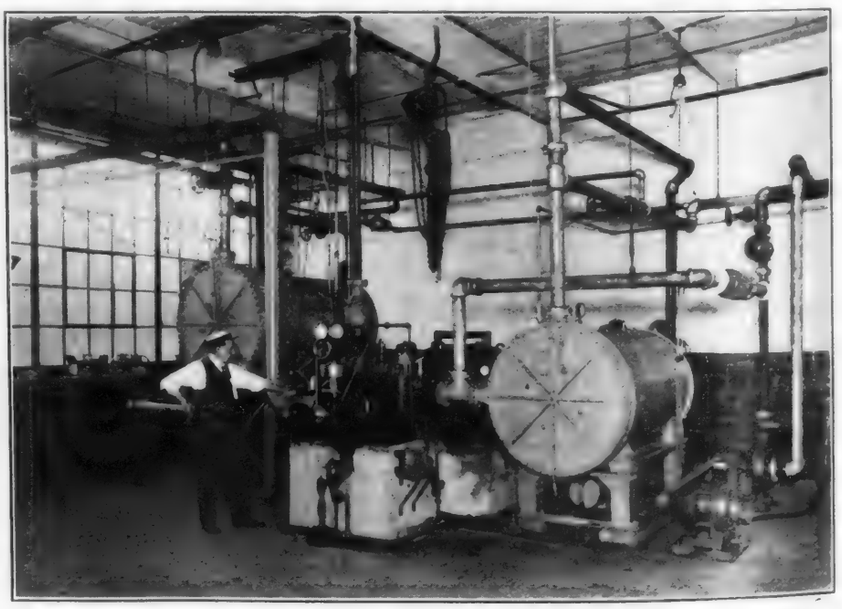
Further details are now available of the new refrigerating machine designed by Willis H. Carrier, of the Carrier Engineering Corporation, Newark, N. J., which was first presented to the public at the concluding meeting for the season of the New York Chapter of the American Society of Heating and Ventilating Engineers, May 22.

In his description of this machine, Mr. Carrier states that when in air conditioning work it became necessary to apply mechanical refrigeration to the cooling of water near its freezing point, it was found that with the commonly used refrigerating mediums, such as anhydrous ammonia or carbon dioxide, certain difficulties were encountered which could only be eliminated by adopting some other medium.

The objections to ammonia were given as: difficulty in uniform distribution of liquid to all coils, oil in the system, danger of freezing up coolers, uniform water flow over all cooler pipes; large cooling surface necessary because k, the coefficient of heat transfer from water to ammonia, is only about 60 B. T. U. per square foot, per hour, per degree F. temperature difference with Baudelot type coolers, or up to 90 B. T. U. with shell and tube type coolers, while in steam condensers k is 400 to 600 B. T. U. The large coolers require a large tank, while for air conditioning, very compact units are preferred. Mr. Carrier said that the ammonia system requires an operating engineer, and if a plant is moved, many parts have to be replaced. While the speed of motors may have to be kept constant, he would want the power expended to drop in proportion as the load decreased.

In order to overcome these and other objections, Mr. Carrier has for about twelve years had in mind the use of a different refrigerating agent, one that could preferably be worked in a centrifugal type of compressor, direct connected to electric motor or steam turbine. Owing to the large ratio of compression and the low density of ammonia, as well as to its high absolute pressure, this refrigerant is not at all suited to centrifugal compression, although these same properties make it ideal for positive compression.

For centrifugal compression, the characteristics of the refrigerant must be quite dissimilar to those required in positive compression. For centrifugal compression, a vapor of high specific density and low ratio of compression and low absolute pressure is essential. The use of a booster with ammonia is profitable only with low temperature work. Owing to the relatively small volume of vapor to be handled, a high-speed turbo ammonia compressor of less than 500 tons refrigerating capacity, would not pay. In the average air conditioning installa-



CARRIER LOW-PRESSURE REFRIGERATING MACHINE IN OPERATION.

tion, 50 tons refrigerating effect is all that is required. Where 100 tons or more capacity is desired, a more flexible arrangement is obtained by employing two or three units rather than one large one.

Even ethyl chloride does not satisfy the requirements, because its volume per ton refrigeration is too small, except for machines of 100 to 150 tons capacity, its latent heat is low, it is inflammable, and has an unpleasant odor.

An entirely acceptable refrigerating fluid, he said, has now been developed. The name of it and its formula, which is a long one, are not to be disclosed until the machine is ready for the market. However, Mr. Carrier describes it as being a perfectly harmless liquid, "as safe as oil," which can be shipped in plain metal oil barrels as it has no action on metals, is perfectly neutral, not inflammable and non-explosive, yet highly volatile, has about the same latent heat per pound as has ethyl chloride, but is of greater specific density. Its boiling point is higher than that of ethyl chloride. Its volume is such that it may be used satisfactorily in centrifugal compressors rated as low as 20 tons.

With this new refrigerating agent, the discharge pressure even with cooling water under summer conditions, is only about 16 in. of mercury absolute, while the ratio of compression for 28° evaporation temperature is about four to one.

Having found a suitable refrigerating substance, the Carrier Engineering Corporation developed a centrifugal compressor having a horizontally disposed main shaft supported by merely two outside main bearings, this compressor being said to have no valves and requiring no lubrication and therefore with no oil on the inside, a condition paralleled in steam turbine practice only. Under the pressures above stated, water can be cooled readily from 40° to 35° F. and without danger of freezing up coolers; and an evaporator has been developed wherein the new low-pressure refrigerant evaporates without ebullition, leaving no film tension to be overcome, which is important when working under a vacuum. Accordingly, a very high rate of heat transfer is obtained, so that when using ⅝-in. copper or brass tubes in the evaporator, about one-fifth of the steel cooling surface commonly furnished, will suffice.

Since the entire system is operating under a vacuum, special provisions must be made to expel all the air entering the apparatus. This is also a necessary condition with steam condensing plants, and it is more difficult there because in that case, vacuums are carried up to 27 in. and 28 in. of mercury. Even with air in the system, the machine remains operative. However special provision is made to exclude air by means of oil seal. The pressure within being only moderately low, the tendency for the air to enter is much less with this machine than with other machines working under vacuum. The quantity of air expelled from the counter flow concentrator is 6 cu. ft. per cubic foot of vapor, while in steam condenser practice, up to 10 cu. ft. of vapor is expelled with each cubic foot of air. The amount of leakage air continuously expelled to the atmosphere is insignificantly small, being measurable only by gradual rise of the liquid level in the glass gauge.

In the new machine, the flash system of evaporation is employed. Expansion valves are not required. A steam trap can be used for feeding the liquid, hence no skilled engineer is necessary for watching the feed. Even if the cooling water is shut off, no accident can happen. Only preliminary tests have so far been conducted on the new machine and therefore no performance data could be submitted at this time. These it is stated, will be forthcoming in due time. The rated capacity of the demonstration machine is 100 tons refrigerating effect, for air conditioning work. While not intended for cooling liquids below 32° F., it may possibly be applied to lower temperatures in future.

Mr. Carrier pointed out that the new machine occupies but little space and that it is quiet in operation, the compressor being less noisy than the horizontal steam turbine driving it. Also that the compressor could be run still faster and that it was an entirely enclosed machine.

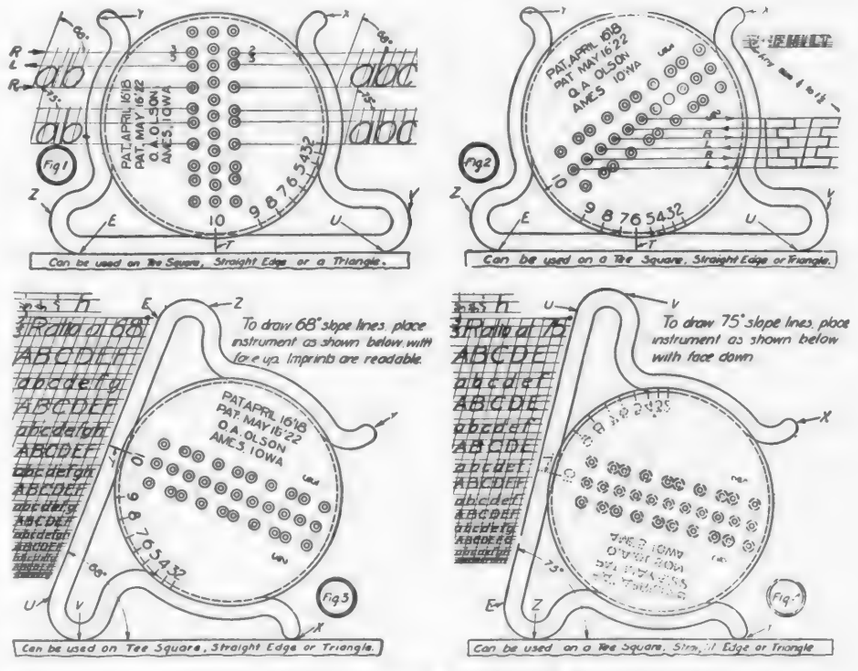


Fig1
Can be used on Tee Square, Straight Edge or a Triangle.
Fig2
Can be used on a Tee Square, Straight Edge or Triangle.
To draw 68° slope lines, place instrument as shown below with face up. Imprints are readable.
Fig3
Can be used on Tee Square, Straight Edge or Triangle.
To draw 75° slope lines, place instrument as shown below with face down
Can be used on a Tee Square, Straight Edge or Triangle

TYPICAL USES OF AMES LETTERING INSTRUMENT.

Ames Lettering Instrument.

An ingenious instrument for the service of the draftsman in connection with lettering work has been designed by Professor O. A. Olson, of the Iowa State College and is now being marketed by the O. A. Olson Mfg. Co., Ames, Ia. It is described as the only instrument of its kind that allows the user to vary the heights of lettering by the adjustment of the dial or disc. It has holes spaced for three different systems of guide lines and provides for the two different slopes preferred by most draftsmen, approximately 68° and 75°. Slope lines can be drawn without any adjustment of the parts. With this instrument guide lines for letters varying in height from ⅛-in. to 1½-in. may be drawn, as well as cross sectioning. For the latter purpose the holes in the center column are used and a T-square or the edge of a triangle placed parallel to the lines.

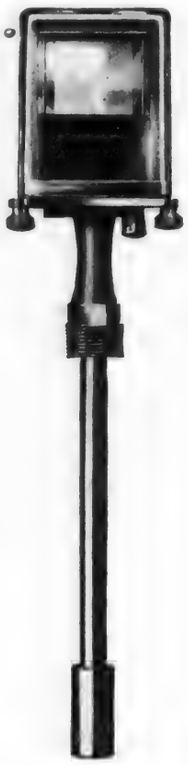
In using the instrument the instructions state that for regular lettering it should be placed on a drawing board with the base bar resting on the upper edge of a T-square. A pencil is then inserted in the proper hole and the instrument made to slide along the edge of the T-square. The position of the instrument is changed for other work, full instructions being given in an accompanying circular. The Ames lettering instrument sells for $1.00.

A Device to Indicate Temperature of Condensate in Return Lines.

One of the interesting devices presented at the "Round Table" of the recent convention of the National District Heating Association was a so-called standard semaphore for use in connection with steam service to indicate certain predetermined maximum temperatures which may occur in the condensate being discharged from the steam service. The application of this device, when connected to the discharge side of "economy" radiation, is intended to show when abnormal or excessively high temperatures have been reached. When installed on condensate lines measured by flow meters and returning to the company's return system, the device may be used in indicate the minimum temperatures of the condensate so returned.

As described by Davis S. Boyden of the Edison Electric Illuminating Company, of Boston, the actuating mechanism of the device is comprised of a bi-metallic element coiled in the form of a helix. The element has a rotating motion which is transmitted to a cam. The cam is recessed at two points at which it releases the shutter which falls half way to the first step, thereby setting a signal of abnormal temperature and, at the second step, to a position indicating excessively high temperature.

This device is provided with a re-setting arrangement, which ordinarily is sealed, to be operated only by a representative of the company. The sensitive element of the signal device is located in the outlet of the economizer where it is affected by temperature of water or steam which discharges to metering equipment or to the company's return steam lines.



DEVICE TO INDICATE TEMPERATURE OF CONDENSATE IN RETURN LINES.

The first signal is set to operate at 125° F., which represents an abnormally high temperature of condensate. The second signal operates at 175° F., which indicates an excessively high temperature or a temperature approaching the vapor point.

Where applied to return lines passing through a condensation meter to waste, this device will call attention to a leaky trap, or any steam by-passing around a trap and consequent passage through the "economy coil" at a high velocity and temperature.

Should the customer, or his agents, to accelerate the time required for raising the temperature of the heating equipment, operate any by-pass or allow the by-pass to remain open sufficiently to raise the temperature to either of the points previously given, a signal would be set which could not be re-set without breaking the seal.

It is the practice to install these heat semaphores in locations where they may be readily observed by the inspector or meter reader. These devices can be made to operate at any other desired temperature. Their simplicity, first low cost with the constant protection of waste of excessively hot condensate, were mentioned as evidence of their value to any steam heating company either measuring by flow or condensate meters, or wasting or reclaiming condensate. The device was designed by Mr. Boyden.

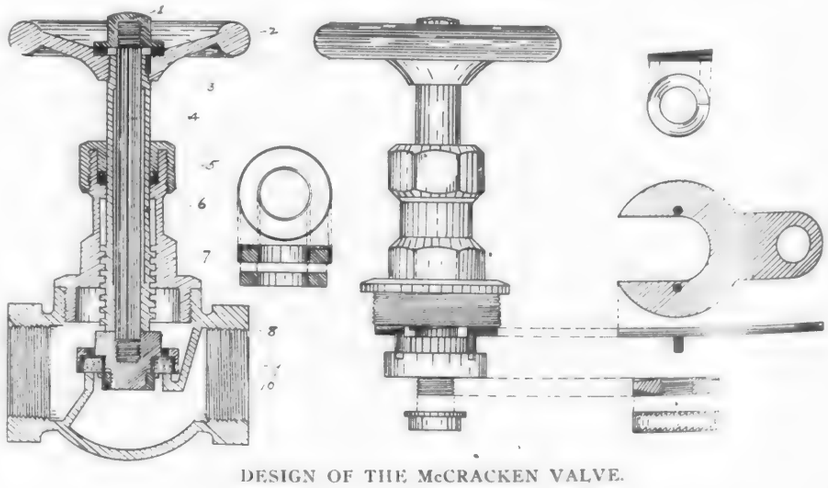
The McCracken Valve.

In the design of the McCracken valve, which is a new type recently patented by George B. McCracken, 55 Mountain St., Willimantic, Conn., Mr. McCracken has attempted to meet certain troubles with which he has often been confronted during his forty years' experience as a master mechanic. These have been due largely to the difficulty of regrinding and reseating a valve with the tools now in use. His problem, therefore, was to design a valve that would do its own reseating without the use of special tools excepting a cutter.

How Mr. McCracken has solved the problem may be seen from the accompanying illustration. In his description of the valve, he states. "This spindle serves a most useful purpose in refacing the seat by its use in connection with a cutter, taking the place of nut (10). Then turning the handwheel (2) giving the desired feed and turning the spindle (4) using any suitable wrench, performs the operation of refacing." Where solid discs are used, they may be reground by the same method as is used in reseating. It is pointed out that the seat does not have to be fastened to the spindle to regrind or to reface because the spindle and disc holder are in one piece.

The disc holder is held firmly against the lower part of the spindle which serves to prevent vibration and wear.

Another point on which stress is laid is that the packing nut and gland are in one piece, simplifying the manufacture of the valve to that extent; also that the ratchet teeth on the gland lessen the trouble of removing the old packing. In short, the construction is intended to eliminate as far as possible, the delicate parts and to lessen the liability of the nuts becoming loose and the seat leaving the spindle.



DESIGN OF THE McCRACKEN VALVE.

Adjustable Fan Frame Now Furnished with Sirocco Ventura Fan.

Ventilation of house kitchens and small rooms is greatly facilitated by an adjustable fan frame. Such a frame, designed to support a small ventilating fan and which fits windows 24 in. to 34 in. wide, is sold with the Sirocco Ventura fan, as a complete unit, by the American Blower Co., Detroit, Mich. It is built of steel and being adjustable it fits any ordinary window. Handles for raising and lowering the window and which screw into the sash are furnished with the frame, as well as the necessary bolts, etc. A screw driver and hammer are the only tools needed in its installation.

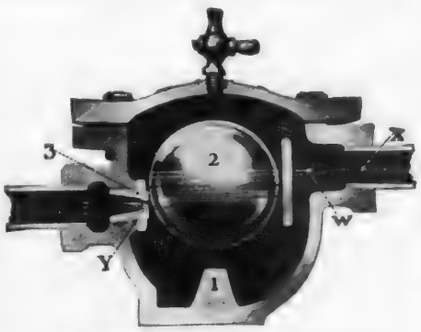
ADJUSTABLE FAN FRAME FOR USE WITH SIROCCO VENTURA FAN.

Fans are furnished with motors for either direct or alternating current and tests have demonstrated that no more electrcity is required than that necessary for a 50-watt lamp. The fan, which is furnished with a cord for attaching to a

nearby socket, has a reversible motor, so that it will not only exhaust stagnant and stuffy air but, at the pull of a string will bring in fresh, outdoor air.

Simplicity in a Steam Trap.

Those who naturally look for diaphragms and compensating levers in a steam trap will find a surprise awaiting them in the new and improved model of the Johns-Manville steam trap which has recently been placed on the market by Johns-Manville, Inc., New York. It is described as the steam trap with only one moving part and that an unattached ball.



NEW DESIGN OF J-M STEAM TRAP.

Our readers are familiar with the action of this trap. The new model shows several refinements of design over earlier models, although the same principle is retained. The body of the trap is large enough to permit withdrawing the ball by hand, but a baffle (seen in the diagram) and two ribs, cast one on each side of the discharge orifice, prevent excessive movement of the ball.

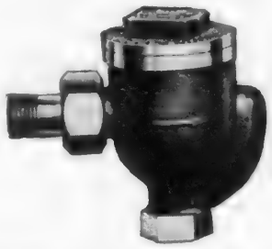
The value of the high, straightway inlet is apparent in reducing the possibility of air pocketing so that the action of the ball is rendered still more free. The discharge bushing is screwed into place from the inside of the trap which permits replacement to meet different condensate conditions without disconnecting the trap from the pipe line. The bushing has a hexagonal head and a heavy flange so that it can be tightened with a wrench against the body of the trap. Such a joint serves to eliminate leakage through the threads and make a gasket unnecessary at this point.

The top of the Johns-Manville radiator trap has also been redesigned the square top being replaced with a hexagonal dome-shaped top, the edge being rounded and polished and extended slightly beyond the body of the trap. This cover has been strengthened so that it will not be necessary to use a gasket between the cover and the body of radiator traps in the future.

The discharge connection of the angle trap is now placed at the bottom and in the center of the body of the trap. This shortens the connection between the radiator and the discharge of the trap.

Other changes include a redesigning of the inner end of the spud, making a true ball swivel joint, and the nut has also been strengthened.

In the past the discharge orifice of the



NEW DESIGN OF J-M RADIATOR TRAP.

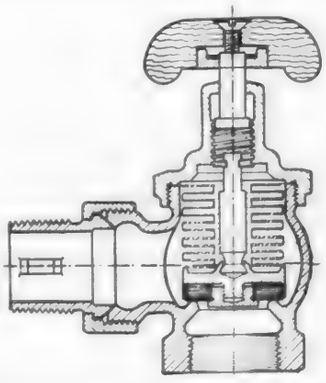
radiator trap has tapered down slightly from the inside. This taper has been eliminated and the orifice is of the same size and shape throughout its length, so that there is no chance of dirt or sediment lodging at that point.

New Dunham Inlet Valve.

A recent arrival in the family of Dunham heating specialties, manufactured by the C. A. Dunham Co., Chicago, Ill., is the Dunham inlet valve. This valve is intended to supplement the Dunham lever-handle top-connection valve in fitting into places that have been closed to the lever-handle type. The new valve, like the

NEW DUNHAM INLET VALVE.

lever-handle valve, is packless. It can be fully opened or closed with approximately one turn of the handle. A series of diaphragms are utilized for free up and down movement of the spindle. The diaphragm construction is also intended to



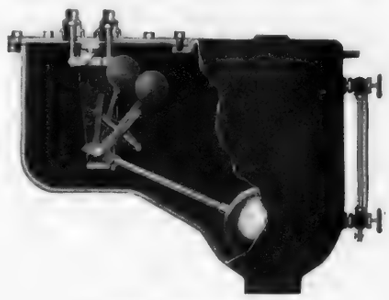
CONSTRUCTION OF NEW DUNHAM INLET VALVE.

serve, of course, in preventing the leakage of air into the system. At the same time this construction prevents steam, water or dirt from the heating system coming into contact with the treads of the valve spindle.

The body of the valve is made of red brass, while the handle consists of a special heat-resisting composition material which is designed not to split or check. The diaphragms are made of a special composition metal and the valves are equipped with renewable composition discs. The new valves are made in six sizes, ranging from ½-in. to 2-in. in angle, straightway, right-hand and left-hand patterns.

The Action of the Illinois Thermo Trap.

In Data Sheet No. 132-LL on the Illinois vapor heating system, published in the July issue, a trick of the types made us say that "care must be taken in its use (the Illinois Thermo trap) to see that it prevents the air from pulling back into the system when the pressure in the system



ILLINOIS THERMO TRAP.

falls below atmospheric pressure—that is, when the system is operated as a vapor system." As a matter of fact, the Illinois Thermo Trap has been designed expressly to prevent the air from pulling back into the system, and this is mentioned by the manufacturers as one of its characteristic features. The company points out that it was the first to apply such a device to a two-pipe system—there had been something similar used on a one-pipe system previously—and the resulting benefits are very considerable as in ordinary winter weather, it is possible to operate the system with the fire banked and a vacuum on the radiators for hours at a time. In mild weather, it is stated, the gauge will not show pressure except during two firing periods of possibly an hour each in the twenty-four hours.

New Publications.

TRADE STANDARDS IN THE PUMP INDUSTRY, second edition, has been published by the Hydraulic Society, which is engaged in a movement to encourage suitable standards of manufacture and of engineering practice in the pump industry and to assist in the development of standard methods of procedure. The recommendations contained in the circular are offered as standard trade definitions and customs for the entire pump industry. In addition to this matter the new edition contains some additional tables and ex-

planatory data that will interest all users of pumps, also a revised list of members of the society. Included in this list are the Advance Pump & Compressor Co., Battle Creek, Mich.; Alberger Pump & Condenser Co., New York; American Steam Pump Co., Battle Creek, Mich.; and the Buffalo Steam Pump Co., Buffalo, N. Y. Copies of the manual may be procured from C. H. Rohrback, secretary, 50 Church St., New York.

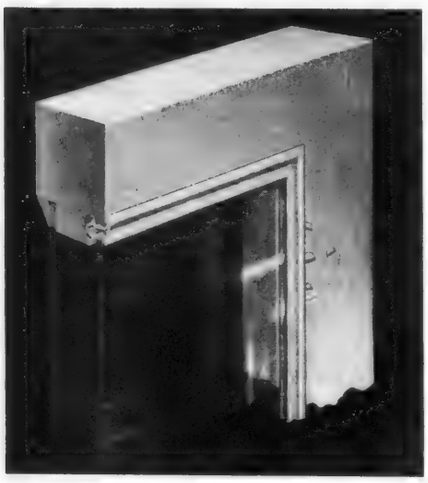
Trade Literature.

WILLIAMSON INFORMATION BOOKLET, for the guidance of the trade in the installation of warm-air heaters and especially the Williamson pipe furnace, is the title of a unique publication issued by the Williamson Heater Co., Cincinnati, O.

It is pointed out by the company that the booklet agrees with the new warm-air furnace code recently promulgated. At the same time, the real purpose is to present the required informatio in such simple form that any furnace installer may readily grasp the information. The booklet, for instance, goes into considerable detail regarding the proper installation of air supply and warm-air runs, the proper location for register faces and cold-air return faces.

The booklet is published in loose-leaf form and is Part I of what will be, when completed, an exhaustive treatise on the subject. Part I, which covers residence heating only, takes up, in order: Making the sketch, determining sizes of pipes for first floor, determining sizes of pipes for upper floors, selecting the plans, the cold-air connection, locating registers and furnace, estimating the job, and flue troubles. The booklet is accompanied by blue-prints, showing typical cold-air connections, boxing between joists and warm-air runs to floor and baseboard registers. Size, 9 x 11 in., Pp. 18.

SULL-SASH, described as a window insulation far superior to the ordinary storm sash, at the same time producing



SECTIONAL VIEW OF SULL-SASH.

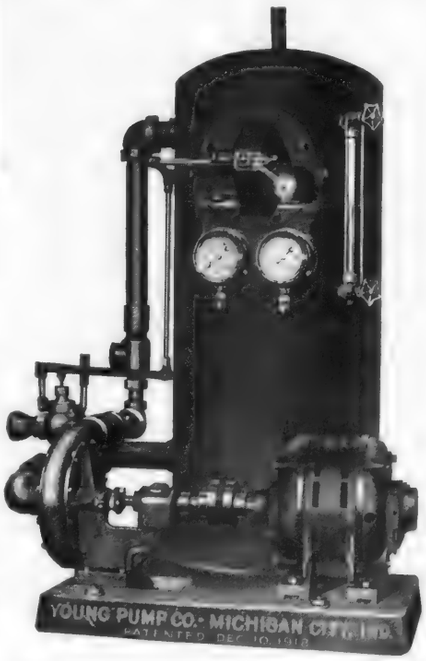
a means of insulating windows otherwise unprotected, is featured in circular matter issued by the Sull-Sash Window Co., 645 Endicott Building, St. Paul, Minn. It is essentially a double-glazed window with two panes of glass in a single sash. The outer pane is the same in every respect as in the ordinary window. The inner pane completes the unit, making a dead air space. The point is made that the efficiency of double glazing is increased as the panes are brought closer together. The efficiency, of course, is further increased when there is no leakage of air between the panes. Finally, when the leakage at the edge of the

ARRANGEMENT OF LOCKS TO PERMIT SULL-SASH TO BE LOCKED OPEN IN TWO POSITIONS.

sash is stopped by means of a good metal weather strip, a window insulation is produced which, it is maintained, is superior to any other type of construction. In the construction of Sull-Sash, the inner pane is so made that it can be instantly removed for cleaning. Otherwise, this inner pane is not intended to be removed, summer or winter. Sull-Sash cannot be applied to old or completed buildings on account of the special groove which must be milled in the sash by the manufacturers. The standard wood sash is used and the company furnishes complete specifications for the milling, as well as a detail of the sash and installation directions. The work of installing is considerably simplified by the special countersink boring tool by which the double holes are made into which fit the fasteners and lock strikes.

CLARAGE KALAMAZOO MULTIBLADE FANS, Type M, especially designed for heating, ventilating and humidifying systems, are brought to the attention of the trade in a notable catalogue (No. 52) which includes complete capacity and dimension tables arranged in a manner that will appeal to the busy engineer and estimator. The capacity tables are made up, it is stated, from actual performance tests and are guaranteed to be correct for standard conditions. Although capacity tables for the double-width, double-inlet fans are not included, the statement is made that it is very easy to figure the capacity for any Clarage double-width, double-inlet fan because a double-width fan will deliver twice the volume of air at the same pressure as that of a single-width, single-inlet fan of the same size when running at the same speed, and will require twice the brake horse-power to drive. The first portion of the catalogue is devoted to notes on the application of Clarage Kalamazoo multiblade fans in schoolhouse work, as well as in theatres and audience halls, hospitals, office buildings and in industrial buildings. The design of the ventilating system is then taken up, followed by the selection of the fan. The various clarage Kalamazoo fan types are described and illustrated, several pages being devoted to details of construction. Size 8½ x 11 in. Pp. 84.

YOUNG CENTRIFUGAL VACUUM AND BOILER-FEED OUTFIT, designed for removing air in condensation for steam heating systems, but equally adaptable for conditions where a wet or dry vacuum is required, is featured in a circular issued by the Young Pump Company, Michigan City, Indiana. The outfit consists of a motor, centrifugal pump and tank, all of which are mounted on the same cast-iron base, with a Young exhaust throat-control by-pass valve, and pressure and



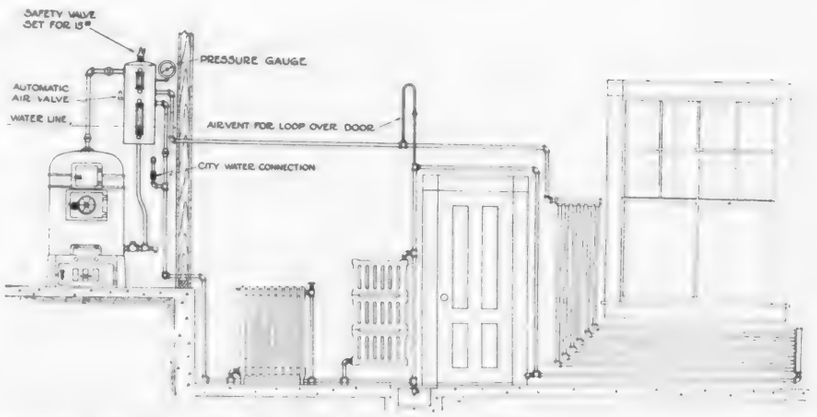
YOUNG CENTRIFUGAL VACUUM AND BOILER-FEED OUTFIT.

vacuum gauges. A suction strainer and a check valve for the return line are furnished with each outfit. When equipped with automatic vacuum control, this outfit, it is stated, will run until the vacuum has reached 9 to 10 in., when the motor will be automatically cut out and it will stand idle until the vacuum has receded to 3 or 4 in. At that point, the motor is automatically started again. The automatic control consists of a vacuum regulator and automatic switch. The outfit can also be supplied with tank water-level control. Standard outfits are made to carry 20 lbs. pressure on the pump and will discharge against this pressure in the boiler, less the friction in the discharge line and the difference between the pump discharge and the water level in the boiler. The pumps are of the side suction type with enclosed impellers, while the tanks are of welded steel. The exhaust is of the company's own design. "YVM" outfits are furnished in five sizes with capacities ranging from 8,000 to 65,000 cu. ft. of direct radiation.

SYLPHON HEATING SPECIALTIES, manufactured by the Fulton Co., Knoxville, Tenn., including temperature and pressure-controlling instruments, valves, etc., are the subject of the first general catalogue issued by the company. The Sylphon bellows is given first place in the catalogue, which then takes up the different types of Sylphon radiator air valves, vent valves for water radiation, quick vent valves for primary heating coils, vent valves for vapor heating systems, air line valves, Sylphon radiator valves of the packless type, Sylphon graduated valves of the packless type, Sylphon radiator valves of the packed type, bonnetless water radiator valves, together with the Sylphon damper regulators for steam boilers, for vapor heating, house-heating water boilers and tank heaters, and warm-air furnaces. A special section of the catalogue is given over to Sylphon temperature regulators of various types, with notes on the adaptability of each type for a given purpose. There is also included a Sylphon humidity controller, the line concluding with the Ja-Nar' radiator cover, Sylphon radiator shield, Sylphon expansion joints and oilers. The necessary dimension data are conveniently arranged for each device, the catalogue concluding with some 30 pages of general information. Size 3¾ x 6¾ in. Pp. 144.

PARKER CIRCULATOR SYSTEM OF HOT WATER HEATING is the title of an interesting circular issued by Parker Bros., Woburn, Mass., featuring the use of this circulator for installations in which the mains and radiators are located below the center of the circulator. This applies to such buildings as garages, churches, greenhouses, stations and apartments where there is frequently little or no circulating head available. The first part of the circular is devoted to an explanation of the principle on which the circulator operates. Use is made of a slight steam pressure in the heater to start and maintain the circulation. The Parker Circulator system it is stated, is designed for use with the ordinary type of water boiler and requires no special apparatus outside of the Parker Circulator tank. The tanks are made in vertical form for the smaller sizes and in horizontal form for the larger sizes. Six sizes are listed, ranging in capacity from 75 sq. ft. to 3000 sq. ft. of radiation.

THE ILG MAN for June, 1922, published by the Ilg Electric Ventilating Co., Chicago, Ill., features the installation of Ilg ventilating equipment installed in the Los Angeles, Cal., vehicular tunnel which is 1000 ft. long. Previous to the installation considerable difficulty had ben experienced in coping with the fumes from automobile exhausts. The improved conditions after the Ilg fans were put in operation was the subject of comment by the local newspapers.



TYPICAL INSTALLATION OF PARKER CIRCULATOR WATER HEATING SYSTEM.

VALVE WORLD for June, 1922, published by Crane Co., Chicago, Ill., has an interesting illustrated article on the Crane Enamelware Company's new plant in Chattanooga, Tenn. The illustrations include a view of Mocassin Bend, Tennessee River, taken from Lookout Mountain.

WEATHER VEIN for June, 1922, published by the Carrier Engineering Corporation, Newark, N. J., contains, among other things, an interesting account of a rush installation of a fan heating system and piping equipment in a building in Cleveland for the E. W. Bliss Company. The story of the installation of the mechanical equipment in the plant of the Hodgman Rubber Company, in Tuckahoe, N. Y., is also told through a series of photographs.

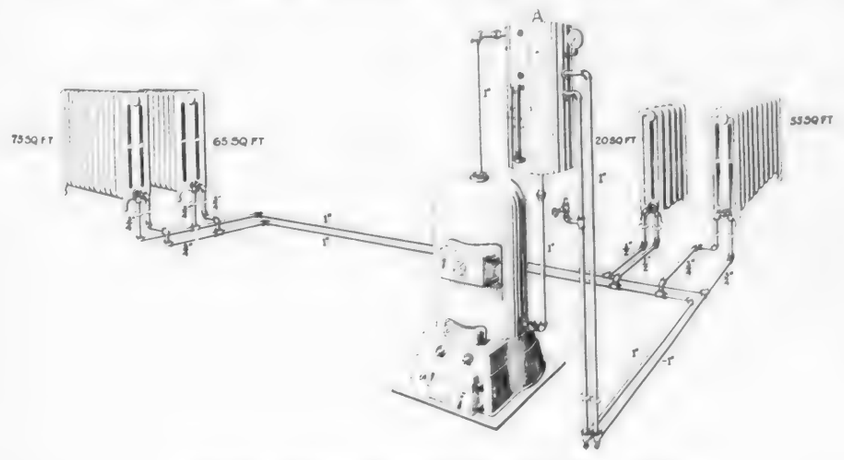
WESTINGHOUSE ELECTRIC WATER HEATER, adapted to the heating of tanks where the temperature required does not exceed 300° F., has been developed by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The heater as described on the company's circular matter, is of the "strap-on" type. Although any metal tank can be heated by this method, the principal demand for the products, it is stated, is for heating water in homes and in small shops.

VALVE WORLD for July, 1922, tells the interesting story, under the heading of "Accidents That Have Made Men Famous," of the discovery of latent heat by Dr. Joseph Black, a university lecturer at Glasgow in 1760.

TRANE DATA, published by the Trane Co., La Crosse, Wis., and devoted to practical information on vapor heating in general and the Trane system in particular, has recently been issued as the seventh edition of the company's bulletin 11. This manual, which has been growing in value with each edition, has now reached a point where it may properly be considered as an authoritative guide in vapor heating work. The bulletin answers the description of a brief, accurate source of vapor heating data, from which all selling talk has been carefully censored. An important improvement over preceding editions is the addition of eight full-page blueprint plates, showing standard installation details for the Trane vapor heating system. The bulletin is really a summarization of fundamental practices in force in the engineering department of the Trane Company, and is intended to supplement, not replace, the work of that department. Size 6x9 in. Pp. 24.

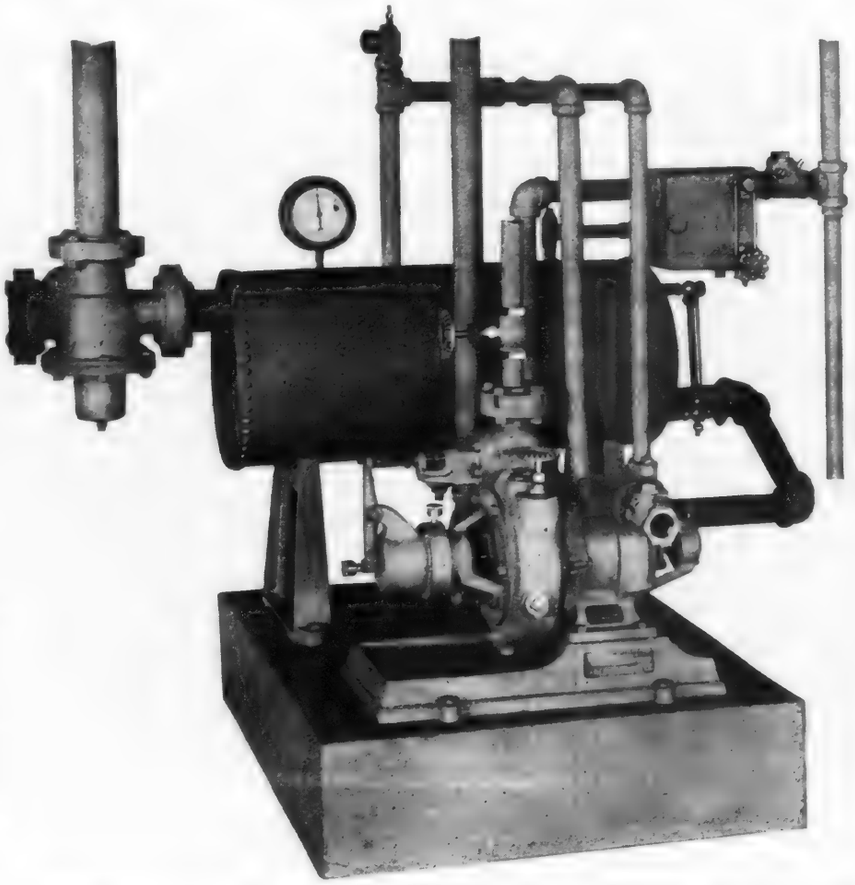
WHAT IS WROUGHT IRON? is the interesting question asked in a recent bulletin (No. 26A) of the A. M. Byers Co., Pittsburgh, Pa., followed by a technical definition of this product, as well as the methods used in its manufacture, and its chemical and physical characteristics. Incidental to the general discussions, sections of the bulletin are devoted to slag distribution, physical properties of wrought-iron, advantages of wrought-iron as a pipe material, resistance to corrosion, and a synopsis of evidence on the corrosion resistance of wrought-iron pipe. The bulletin is profusely illustrated. Size 8½x11 in. Pp. 40.

JENNINGS HYTOR VACUUM HEATING PUMP, STEAM TURBINE DRIVEN, for return-line heating systems, dryer exhaust in paper mills and other vacuum work where liquid is handled with a gas, is the subject of a new catalogue (Bulletin 18) issued by the Nash Engineering Co., South Norwalk, Conn., and is remarkable for the clear idea it gives, through the use of natural colors in the illustrations,



PARKER CIRCULATOR WATER HEATING SYSTEM

of the materials used in its construction, as well as its operating characteristics. The company states that the success of these pumps as operated by electric motors has led to the development of a steam-turbine drive for them. A colored cross-sectional cut shows verly clearly the general design of the steam-driven outfit, by which it will be noted that the turbine wheels used is the Terry type in which the rotating element consists of a solid steel forging with blades milled out of the rim. The standard units for 10 lbs. pressure are supplied in five regular sizes capable of taking care of from 8,000 to 65,000 sq. ft. of direct radiation. Larger pumps up to 300,000 sq. ft. capacity are also supplied. Size 7½ x 10½ in. Pp. 8.

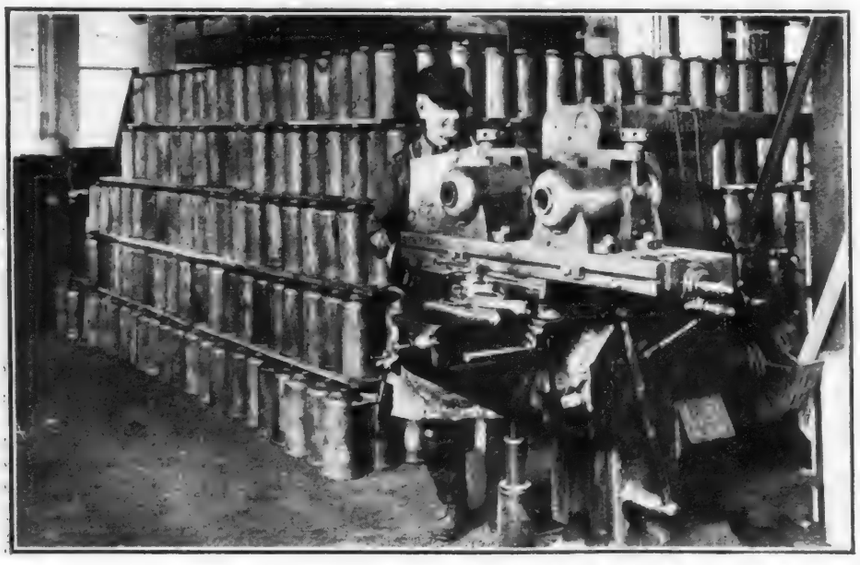


JENNINGS HYTOR VACUUM HEATING PUMP (STEAM-TURBINE DRIVEN) COMPLETELY PIPED UP.

Popularity of Trane Direct-Return Traps for Heating Systems.

In calling attention to its line of direct-return traps, the Trane Company, of La Crosse, Wis., in a recent advertisement in these columns, pointed out how engineers and heating contractors have long realized that vapor heating systems, or any system of heating where the radiators are equipped with thermostatic traps for gravity installations, require some positive means of forcing the return water back to the boiler during those periods when the difference in pressure between the boiler and the return pipe is such as to prevent the return of the condensation by gravity. How this need is met by the Trane direct-return traps was brought out very effectively, being supplemented by the accompanying illustration showing a large number of these traps, some of them being in the course of manufacture. The reference to that illustration was intended to read: "The photo reproduced here, taken May 1, 1922, illustrates the popularity of the Trane Company's answer to this problem."

The importance which the company attaches to this product may be gauged from its statement that "broken boilers and Trane direct-return traps are never found on the same system." These traps are furnished as standard equipment for the Trane system of vapor heating.



MEETING THE DEMAND FOR TRANE DIRECT-RETURN TRAPS.

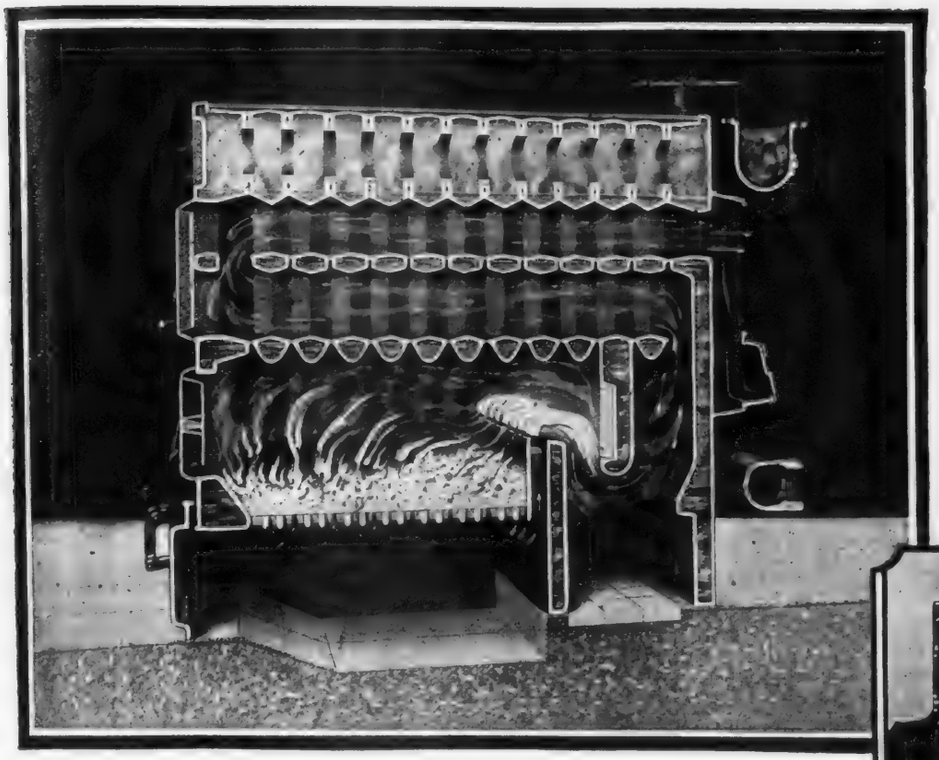
Further Particulars of the District Heating Engineers' One-Act Sketch.

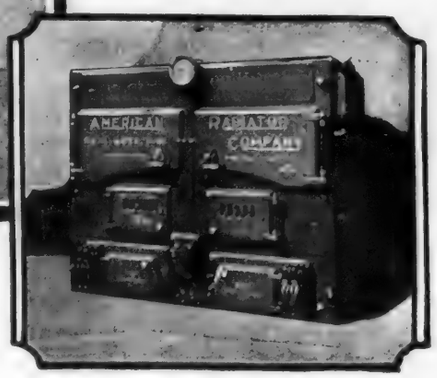
It is now possible to lift the veil which surrounded the production of the one-act sketch at the banquet of the National District Heating Association in connection with its recent convention at Cedar Point, O. As the author of the sketch writes, "now that the laurels and the plaudits of the multitude have been won, it is unjust to the world at large that such shining lights should remain hidden under a bushel." The title of what was described as "a one-act hot sketch (steam heated)," was "A Busy Day," written by Goodness Knowswho. Included in the dramatis personae were the following: Mr. A. Busiman, manager Middle Warming Co.; Douglas Pickbanks (William Owen); Miss Millicent Smithers, stenographer, Mary Millford (J. Earl Seiter); A. Dumbell, handyman, Ford Chapling (N. W. Calvert); Mr. Con. Soomer one of the company's victims, Lionel Barrymuch (W. K. Abernathy); Mr. Alite Waite, a building engineer, Mack Sentfor (Charles H. Day). Time, A. D. 1922. Place, somewhere in the U. S. A. Scene, office of the Middle Warming Company.

William T. Harms, president of the Michigan Chapter, A. S. H. & V. E. welcomed the heating engineers to Detroit on the occasion of their recent mid-summer meeting in that city. In our report Mr. Harms's name was given as George A. Harms.

Deaths.

William J. Scholl, founder and president of the W. J. Scholl [illegible] Co., Youngstown, O., was killed [illegible] speeding automobile in front of [illegible] home in Youngstown on the evening [illegible] June 15. He was 66 years old.





Making Coal Work!

MAN is often a victim of his environment. So also is coal. It refuses to do good work except under ideal circumstances.

In the fire-pot and flue chambers of the IDEAL 79" WATER TUBE BOILER coal works as it never worked before. Study the cross section of this boiler above.

Notice how the walls of the large fire-box and ash-pit are *waterfilled*. The radiant heat, given off by the intensely hot flame, is completely absorbed. Passing to the rear the gases move over a water-backed bridge wall into a large combustion chamber, then travel upward and forward into the lower gallery of tubes.

Reaching the front, these gases, having given up most of their heat, rise into the upper gallery of tubes where they sift to the rear, passing out through the smoke-hood with practically all heat extracted.

Smokeless combustion is obtained by admitting highly heated air at the bridge wall which mingles with the unburned gases and causes them to be completely consumed in the combustion chamber.

Making coal work is but one of many advantages of the IDEAL 79" WATER TUBE BOILER. It has so many new and interesting points of construction that a booklet is necessary to present them adequately.

Your name on your letterhead will bring a copy to you. Address the nearest office below.

AMERICAN RADIATOR COMPANY

IDEAL Boilers and AMERICAN Radiators for every heating need

AMERICAN IDEAL RADIATORS BOILERS

104 West 42nd Street, New York Dept 106 816 So. Michigan Avenue, Chicago

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. CITY

RADIATION COMPUTING.

Heating - Steam

24" Brick Wall Lath furring and plaster on inside

Net Exp. Wall	Direct Radiation S. or S.E.	N. or N.W.	W. or N.E.	E. or S.W.	Net Exp Wall	Direct Radiation S. or S.E.	N. or N.W.	W. or N.E.	E. or S.W.
20	1	2	1	1	900	64	68	63	59
40	2	3	3	3	920	65	69	65	60
60	4	5	4	4	940	66	71	67	62
80	5	6	6	5	960	68	72	68	63
100	6	8	7	7	980	69	74	69	64
120	7	9	8	8	1000	60	75	70	65
140	8	11	10	9	1020	61	77	72	67
160	10	12	11	10	1040	62	79	74	68
180	11	14	13	12	1060	64	80	75	69
200	12	15	14	13	1080	65	81	76	71
220	13	17	15	14	1100	66	83	77	72
240	14	19	17	16	1120	67	84	79	73
260	16	20	19	17	1140	68	86	81	74
280	17	21	20	18	1160	70	87	82	76
300	18	23	21	20	1180	71	89	83	77
320	19	24	22	21	1200	72	90	84	78
340	20	26	24	22	1220	73	92	86	79
360	22	27	25	23	1240	74	93	88	80
380	23	29	27	25	1260	76	95	89	82
400	24	30	28	26	1280	77	96	90	84
420	25	32	29	27	1300	78	98	91	85
440	26	33	31	29	1320	79	99	93	87
460	28	35	32	30	1340	80	101	95	88
480	29	36	34	31	1360	82	102	96	89
500	30	38	36	33	1380	83	104	97	90
520	31	39	36	34	1400	84	105	98	91
540	32	41	38	35	1420	85	107	100	93
560	34	42	39	36	1440	86	109	102	94
580	35	44	41	38	1460	88	110	103	95
600	36	45	42	39	1480	89	111	104	97
620	37	47	43	40	1600	90	113	105	98
640	38	49	45	41	1520	91	114	107	100
660	40	50	47	42	1540	92	116	109	101
680	41	51	48	44	1560	94	117	110	102
700	42	53	49	45	1680	95	119	111	103
720	43	54	51	46	1600	96	120	112	104
740	44	56	53	47	1620	97	122	114	106
760	46	57	54	48	1640	98	123	116	107
780	47	59	56	50	1660	100	125	117	108
800	48	60	56	52	1680	101	126	118	110
820	49	62	58	53	1700	102	128	119	111
840	50	63	60	54	1720	103	129	121	113
860	52	65	61	56	1740	104	131	123	114
880	53	66	62	58	1760	106	132	124	115

P.A.C

RADIATION COMPUTING—Steam Heating, 24-in. Brick Walls. | No. 13-M.

Copies of this Data Sheet, printed separately, 5 cents each.

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. CITY

RADIATION COMPUTING.

Heating - Steam -

16" Stone or Concrete Wall Lath furring and plaster on inside

Net Exp. Wall	Direct Radiation S. or S.E.	N. or N.W.	W. or N.E.	E. or S.W.	Net Exp. Wall	Direct Radiation S. or S.E.	N. or N.W.	W. or N.E.	E. or S.W.
20	3	4	3	3	900	126	158	144	135
40	6	7	6	6	920	129	161	147	138
60	8	11	10	9	940	132	165	150	141
80	11	14	13	12	960	134	168	154	144
100	14	18	16	15	980	137	172	157	147
120	17	21	19	18	1000	140	175	160	150
140	20	25	22	21	1020	143	179	163	153
160	22	28	26	24	1040	145	182	166	156
180	25	32	29	27	1060	148	186	170	159
200	28	35	32	30	1080	151	189	173	162
220	31	39	36	33	1100	154	193	176	165
240	34	42	38	36	1120	158	196	179	168
260	36	46	42	39	1140	161	200	182	171
280	39	49	45	42	1160	163	203	186	174
300	42	53	48	45	1180	166	207	189	177
320	45	56	51	48	1200	168	210	192	180
340	48	60	54	51	1220	171	214	195	183
360	50	63	58	54	1240	174	217	198	186
380	53	67	61	57	1260	176	221	202	189
400	56	70	64	60	1280	179	224	206	192
420	59	74	67	63	1300	182	228	208	195
440	62	77	70	66	1320	185	231	211	198
460	64	81	74	69	1340	188	235	214	201
480	67	84	77	72	1360	190	238	218	204
500	70	88	80	75	1380	193	242	221	207
520	73	91	83	78	1400	196	246	224	210
540	75	95	86	81	1420	199	249	227	213
560	78	98	90	84	1440	202	252	230	216
580	81	102	93	87	1460	204	256	234	219
600	84	105	96	90	1480	207	259	237	222
620	88	109	99	93	1500	210	263	240	225
640	91	112	102	96	1520	213	266	248	228
660	93	116	106	99	1540	215	270	246	231
680	95	119	109	102	1560	218	273	250	234
700	98	123	112	105	1580	221	277	253	237
720	101	126	115	108	1600	224	280	256	240
740	104	130	118	111	1620	228	284	259	243
760	106	133	122	114	1640	231	287	262	246
780	109	137	125	117	1660	233	291	266	249
800	112	140	128	120	1680	235	294	269	252
820	115	144	131	123	1700	238	298	272	255
840	118	147	134	126	1720	241	301	275	258
860	120	151	138	129	1740	244	305	278	261
880	123	154	141	132	1760	246	308	282	264

R.A.C.

RADIATION COMPUTING—Steam Htg., 16-in. Stone or Concrete Wall. | NO. 13-N.

Copies of this Data Sheet, printed separately, 5 cents each.

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. CITY

RADIATION COMPUTING.

Heating - Steam -

18" Stone or Concrete Wall Lath furring and plaster on inside

Net Exp. Wall	Direct Radiation S. or S.E.	N. or N.W.	W. or N.E.	E. or S.W.	Net Exp. Wall	Direct Radiation S. or S.E.	N. or N.W.	W. or N.E.	E. or S.W.
20	3	5	3	3	900	121	149	135	126
40	6	7	6	6	920	124	153	138	129
60	8	10	9	8	940	126	156	141	132
80	11	13	12	11	960	129	159	146	134
100	14	17	15	14	980	131	163	147	137
120	16	20	18	17	1000	134	166	150	140
140	19	23	21	20	1020	137	169	153	143
160	22	26	24	22	1040	139	172	156	146
180	24	30	27	25	1060	142	176	159	148
200	27	33	30	28	1080	145	179	162	151
220	30	36	33	31	1100	148	182	165	154
240	32	40	36	34	1120	150	186	168	157
260	35	43	39	37	1140	153	189	172	160
280	38	46	42	39	1160	156	193	175	162
300	41	50	45	42	1180	158	196	177	165
320	43	53	48	46	1200	161	199	180	168
340	46	56	51	48	1220	164	203	183	171
360	49	59	54	50	1240	166	205	186	174
380	51	63	57	53	1260	169	209	189	177
400	54	66	60	56	1280	171	212	192	179
420	57	69	63	59	1300	174	215	195	182
440	59	73	66	62	1320	177	219	198	186
460	62	76	69	64	1340	179	222	201	188
480	65	79	72	67	1360	182	226	204	190
500	68	83	76	70	1380	185	229	207	193
520	70	86	78	73	1400	188	232	210	196
540	73	89	81	76	1420	190	236	213	199
560	76	92	84	78	1440	193	239	216	202
580	78	96	87	81	1460	196	243	219	204
600	81	99	90	84	1480	198	246	222	207
620	84	102	93	87	1500	201	249	225	210
640	86	106	96	90	1520	204	253	228	213
660	89	109	99	92	1540	206	255	231	216
680	91	113	102	95	1560	209	259	234	218
700	94	116	105	98	1580	211	262	237	221
720	97	119	108	101	1600	216	264	240	224
740	99	123	111	104	1620	217	269	243	227
760	102	126	114	107	1640	219	272	246	240
780	105	129	117	109	1660	222	276	249	242
800	108	132	120	112	1680	225	279	252	245
820	110	136	123	115	1700	229	281	256	248
840	113	139	126	118	1720	230	286	258	251
860	116	142	129	120	1740	233	289	261	254
880	118	146	132	123	1760	236	293	264	257

P.H.C.

RADIATION COMPUTING—Steam Htg., 18-in. Stone or Concrete Wall No. 13-O.

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THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. CITY

RADIATION COMPUTING.

Heating - Steam -

20" Stone or Concrete Wall. Lath furring and plaster on inside

Net Exp. Wall.	Direct Radiation S. or S.E.	N. or N.E.	W. or N.E.	E. or S.W.	Net Exp. wall	Direct Radiation S. or S.E.	N. or N.W.	W. or N.E.	E. or S.W.
20	3	3	3	3	900	113	144	130	121
40	5	6	6	5	920	115	147	133	124
60	8	10	9	8	940	118	150	135	126
80	10	13	12	11	960	120	154	138	129
100	13	16	15	14	980	123	157	141	131
120	15	19	17	16	1000	125	160	144	134
140	18	22	20	19	1020	128	163	147	137
160	20	26	23	22	1040	130	166	149	139
180	23	29	26	24	1060	133	170	152	142
200	25	32	29	27	1080	135	173	158	146
220	28	35	32	30	1100	138	176	158	148
240	30	38	35	32	1120	140	179	161	150
260	33	42	38	35	1140	143	182	164	153
280	35	45	41	38	1160	145	186	166	156
300	38	48	44	41	1180	148	189	164	158
320	40	51	46	43	1200	150	192	172	161
340	43	54	49	46	1220	153	195	175	164
360	45	58	52	49	1240	155	198	178	166
380	48	61	56	51	1260	158	202	181	169
400	50	64	58	54	1280	160	206	184	171
420	53	67	61	57	1300	163	208	187	174
440	55	70	64	59	1320	165	211	190	177
460	58	74	67	62	1340	168	214	193	179
480	60	77	70	65	1360	170	218	195	182
500	63	80	73	68	1380	173	221	198	186
520	65	83	75	70	1400	175	224	201	188
540	68	86	78	73	1420	178	227	204	190
560	70	90	81	76	1440	180	230	207	193
580	73	93	84	78	1460	183	234	209	196
600	75	96	87	81	1480	185	237	212	198
620	78	99	89	84	1500	188	240	215	201
640	80	102	92	86	1520	190	243	218	204
660	83	106	95	89	1540	193	246	221	206
680	85	109	98	91	1560	195	250	224	209
700	88	112	101	94	1580	198	253	226	211
720	90	115	104	97	1600	200	256	229	214
740	93	118	106	99	1620	203	259	232	217
760	96	122	109	102	1640	205	262	235	219
780	98	126	112	105	1660	208	266	238	222
800	100	128	115	108	1680	210	269	241	225
820	103	131	118	110	1700	213	272	244	228
840	105	134	121	113	1720	215	275	247	230
860	108	138	124	116	1740	217	278	250	233
880	110	141	127	118	1760	220	282	253	236

P.A.C.

RADIATION COMPUTING—Steam Htg., 20-in. Stone or Concrete Wall. | No. 13-P.

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THE MOST ECONOMICAL AIR COMPRESSOR AND VACUUM PUMP NASH HYTOR

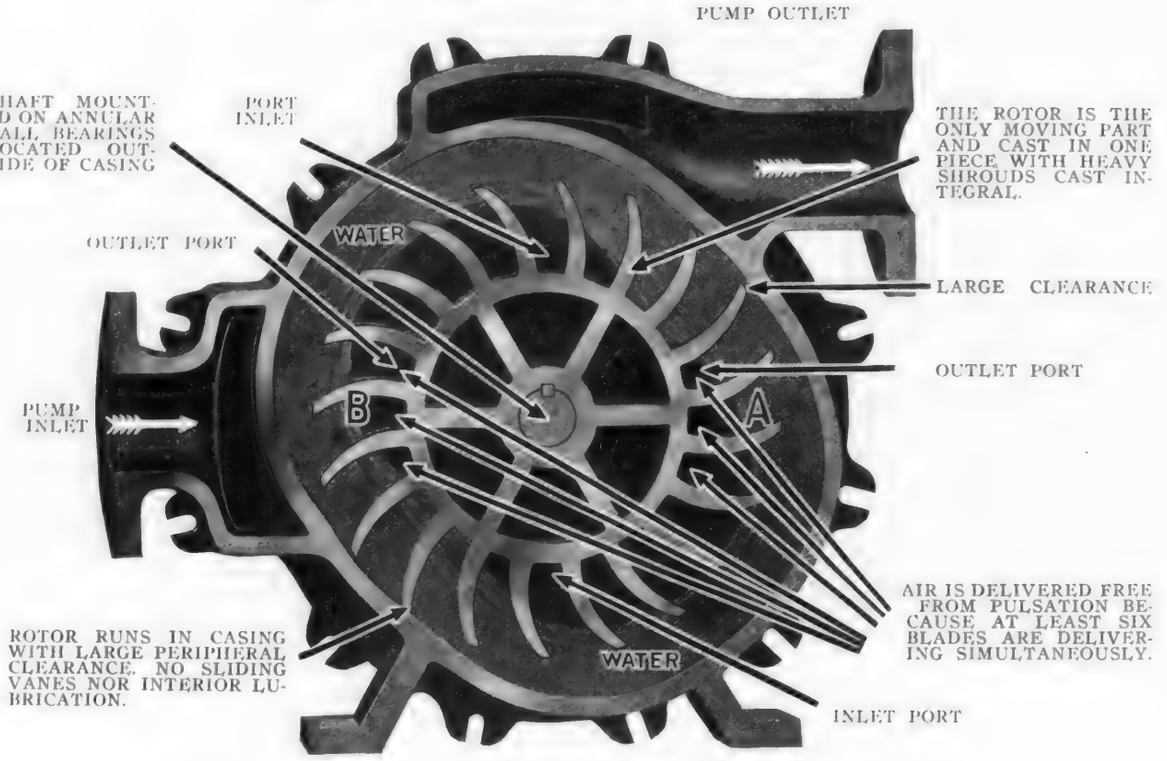
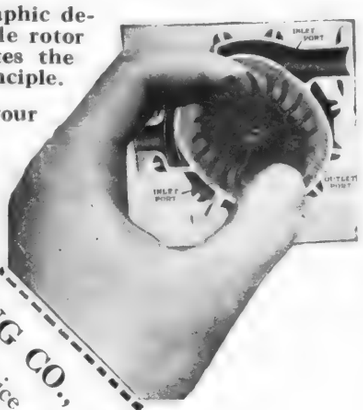

PUMP OUTLET
SHAFT MOUNTED ON ANNULAR BALL BEARINGS LOCATED OUTSIDE OF CASING
PORT INLET
THE ROTOR IS THE ONLY MOVING PART AND CAST IN ONE PIECE WITH HEAVY SHROUDS CAST INTEGRAL.
WATER
OUTLET PORT
LARGE CLEARANCE
OUTLET PORT
PUMP INLET
B
A
AIR IS DELIVERED FREE FROM PULSATION BECAUSE AT LEAST SIX BLADES ARE DELIVERING SIMULTANEOUSLY.
ROTOR RUNS IN CASING WITH LARGE PERIPHERAL CLEARANCE. NO SLIDING VANES NOR INTERIOR LUBRICATION.
WATER
INLET PORT

Diagram illustrating unique principle of operation

A ROTOR in hydraulic balance revolves freely in an elliptical casing filled with water. The water, turning with the rotor, and constrained to follow the casing by centrifugal force, alternately recedes from and is forced back into the rotor, twice in a revolution. As the water recedes from the rotor it draws in air through the inlet ports. When the water is forced back into the rotor by the converging casing, the air is first compressed and then discharged through the outlet ports.

This celluloid graphic device with movable rotor clearly illustrates the operating principle.

Send for your copy.



The HYTOR COMPRESSOR is valveless, has no gears, loose moving or reciprocating parts, no piston packing to renew, no cylinders to lubricate and no bearing adjustments to make.

The rotor, the only moving part, is cast in one piece, the blades being rigidly reinforced by shrouds. The rotor is mounted on a short stiff shaft supported at each end by the highest grade annular ball bearings mounted outside of the casing.

As the peripheral clearance is large, there is no possibility of the ends of the rotor blades coming in contact with the casing.

The original high efficiency is maintained indefinitely in continuous service.

The air is thoroughly washed during compression and contains no oil.

Hytor compressors occupy very much less floor space and are much lighter in weight than reciprocating compressors. They run without vibration.

The cost of installation is greatly reduced as no expensive foundations are necessary.

No expert attendance is required as there are no adjustments to make. The cost of upkeep is negligible.

Hytor compressors are quiet in operation.

NASH ENGINEERING CO.
SO. NORWALK, CONN., U. S. A.

NASH ENGINEERING CO., SOUTH NORWALK, CONN., U. S. A.

Please send graphic device also bulletins covering
( ) Hytor Air Compressors
( ) Hytor Vacuum Pumps
( ) Return Line Heating Pumps
( ) Boiler Feed Pumps

NAME .....
ADDRESS .....
COMPANY .....
POSITION .....

TRADE AND MISCELLANEOUS NOTES

Miscellaneous Notes.

Chicago, Ill.—Recent reports on the use of air from Chicago's freight tunnel for cooling building in summer and heating them in winter show that this method continues to be a success. The temperature of the tunnel air during the summer is practically constant at 70°F. "Theatres which tap the tunnel for cool air use approximately 1,000,000 cu. ft. per minute when all are in operation," according to Ralph M. Ensign, chief engineer for the Phillips-Getschow Company, which has constructed the ventilating system for a number of the "loop" theatres. In winter, it is stated, the air never gets below 55° F., so that it is only necessary to heat it a few degrees to obtain comfortable conditions. The Chicago Tunnel Company does not charge for the air because of the benefit derived from getting a better circulation in the tunnel.

Frank Espy, vice-president and general manager of the Ohio Power Company, Canton, O., was elected vice-president of the Ohio Electric Light Association, at its 28th annual convention at Cedar Point recently. E. L. Franklin, of Warren, was elected president, and D. L. Gaskill, of Greenville, re-elected secretary-treasurer.

Columbus, O.—Fifty years at the helm of a stationary engine without an accident is the enviable record of R. W. Jones, chief engineer of the London, O., public schools. Mr. Jones is 68 years old and is the inventor of a vacuum control system for heating plants which acts to relieve unruly steam systems from knocking.

Washington, D. C.—Figures received by the Department of Commerce up to June 20 indicate that the revival in business is getting on more substantial grounds. Among the favorable features were the continued advance increase in the iron and steel industry which on that date was operating above the pre-war level, the sustained activity in the building industry which continues to make new high records each month, the marked increase in the production of automobiles and trucks, the lower interest rates and increasing demand for money, the increase in employment and the decline in business failures. Building contracts awarded in the 27 northeastern States in May totaled $302,590,000, or nearly $10,000,000 greater than in April. The square feet of floor space reported amounted to 59,639,000. This established new high records for the industry, both in value and volume. Residential buildings were valued at $140,933,000, compared with $132,478,000 in April. Business buildings accounted for $57,515,000 and industrial buildings another $23,893,000. Public works and public utilities were valued at $63,817,000, a decrease of nearly $12,000,000 compared with April, but far higher than any other month in the past year and a half. All index numbers of construction costs increased during May.

Providence, R. I.—Despite the increased building activity in the United States during the last six months, the housing shortage for the country as a whole is estimated as somewhat more than two and a half years' production by John Ihlder, manager of the Civic Development Department of the Chamber of Commerce of the United States. According to Mr. Ihlder the situation is not the same in all American cities. In some cities the shortage is estimated as nearly four years, he said, while in

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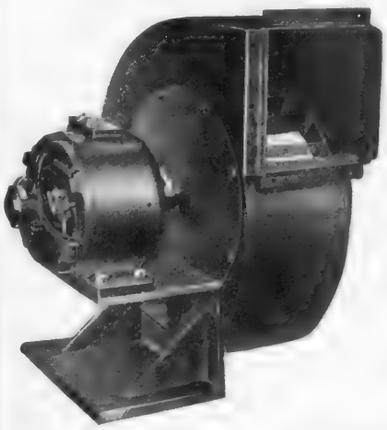

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is now ready. Every architect, engineer and sheet metal worker should have a copy of this "Modern Encyclopedia of Engineering Data."

Bulletin No. 56

very fully covering every detail pertaining to the "Autovent Window Ventilator" is also ready for distribution.

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others, it is approximately one and a half years, or even less.

New York.—Reports of labor shortages are increasing in number and including common labor as well as skilled and semi-skilled, according to a nation-wide survey by the National Industrial Conference Board, 10 East 39th Street, New York City. The continued reports of unemployment from some sections, contrasted with labor shortages reported in others, indicate, the board says, that there is at present a large dislocation of labor supply, and that as business conditions improve more difficulties will be met in securing desired help, which may develop into a national problem of some importance. The limitation of immigration by law during the next two years will play a large part in this situation.

O. P. Hood, chief mechanical engineer of the Bureau of Mines, sailed on July 12 for London. Mr. Hood will spend three months in Europe studying new developments in lignite utilization and the low-temperature carbonization of coal, for the purpose of applying the information to studies in lignite and fuel utilization now being conducted under his direction in the United States by the Bureau of Mines.

Arbitration Society of America is the title of an organization recently formed in New York which has devised a method for the settlement, by prominent laymen, acting as arbitrators, of business and other disputes. Action will be secured through a Tribunal of Arbitration which is now open for business. Permanent quarters for the Tribunal will soon be secured in New York. Emerson McMillan, a banker, is president of the association; Samuel McCune Lindsay of Columbia University and Moses H. Grossman, lawyer, are vice-presidents; and Jules S. Bache, treasurer. The Tribunal's power is derived from a law passed in 1920 which provides that any persons who wish to arbitrate a dispute may select an arbitrator to hear their case. Once they agree to do so their decision is irrevocable. The arbitrator has the power of subpoena, the power to render a judgment, financial or otherwise, and there is no appeal.

Washington, D. C.—Uniform cost accounting methods have been adopted by approximately 120 commodity lines, according to a survey just completed by the Fabricated Production Department of the Chamber of Commerce of the United States. According to the

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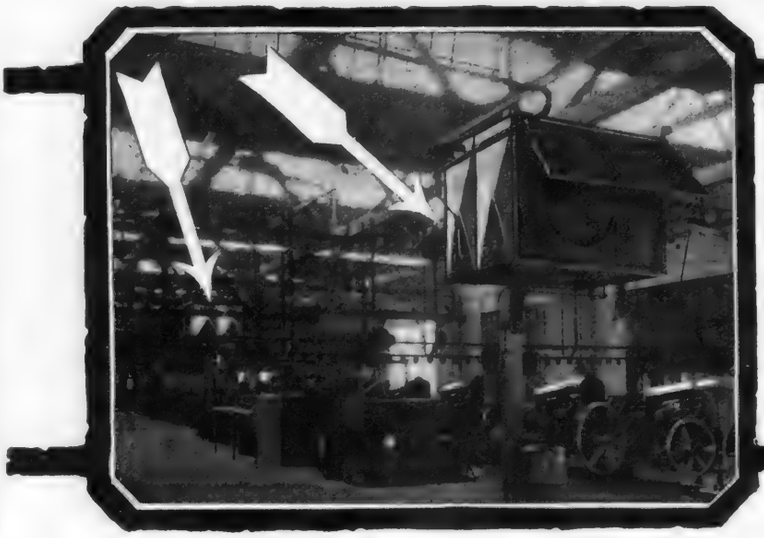

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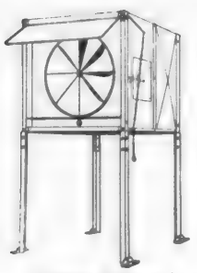

Floor Type
Note Ceiling Type in Picture

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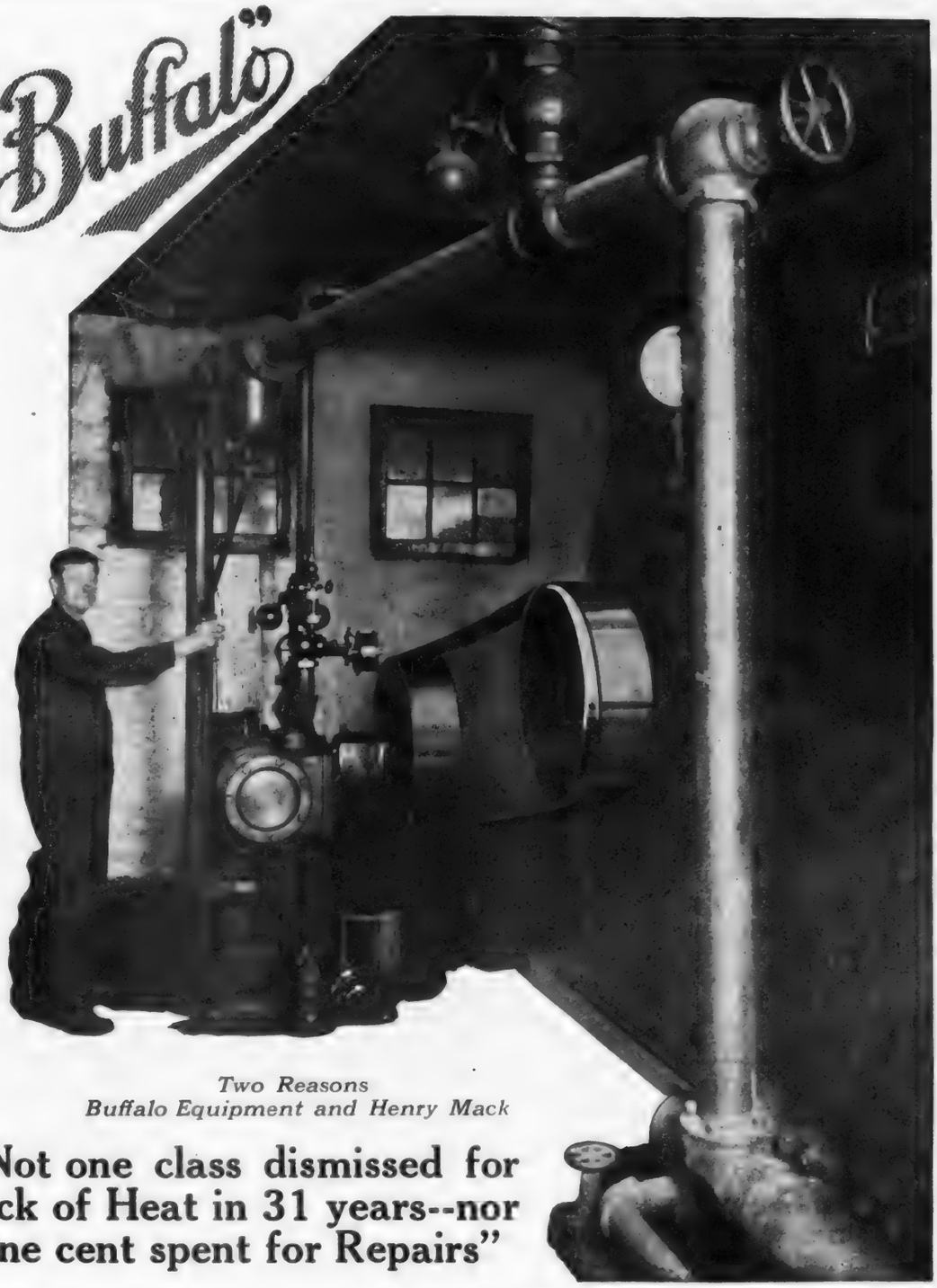


Two Reasons
Buffalo Equipment and Henry Mack

"Not one class dismissed for lack of Heat in 31 years--nor one cent spent for Repairs"

It is nothing unusal for us to hear of Buffalo Ventilating Fans and Engines that have been in use for thirty odd years but seldom are they under the charge of one man as has been the case in the Roosevelt School, Canton, Ohio.

Mr. Mack makes, and the school officials agree to the quoted statement above.

Mr. Mack's community can well be proud of him and his remarkable record of fidelity and efficiency.

We are proud of Buffalo Equipment and would appreciate an opportunity to tell you more about it.

Send for Catalog No. 36

BUFFALO FORGE COMPANY
BUFFALO, N. Y.

survey, forty lines have gone the whole distance in the adoption of uniform cost systems and in securing general use of them in their industries; approximately the same number have adopted complete uniform methods, and are now facing the important problem of installing such systems, while the remainder have only worked out plans for simplification of accounts.

As shown by the survey, the commodity lines which are successfully using uniform cost methods include steel barrels, malleable castings, electrical contracting, pressed steel, power piping and stoves.

National Safety Council has completed its program for the Eleventh Annual Safety Congress in Detroit, August 28 to September 1. All meetings will be held in the new Cass Technical High School which is characterized as one of the finest educational institutions of its kind in the country. Practically all of the available space has been taken for the safety exhibit which will be held in a large hall immediately adjoining the main auditorium.

National Association of Practical Refrigerating Engineers will hold its thirteenth annual convention in St. Louis, November 1-4, 1922, at the Planters Hotel. The association is composed of chief and operating engineers. It has compiled a notable lecture course in twenty parts for the benefit of its members. The secretary is Edward H. Fox, 5707 West Lake Street, Chicago.

San Francisco, Cal.—An association of all branches of the heating and plumbing industries in California, including manufacturers, jobbers and contractors, has been formed with the purpose of giving the various groups in these industries a better understanding of each others' problems and of obtaining co-operation in making the public familiar with their accomplishments, aims and difficulties.

Eastern Supply Association, at its summer meeting in New York, June 14, added a number of firms to its roll of members, including the American District Steam Company.

Chicago, Ill.—A $5,000,000 apartment building project has been developed in Chicago. It is proposed to build a row of large apartment houses, comprising over 400 apartments of four, five and six rooms each. Plans for the first five units, it is stated, have already been drawn by the architects. The first building will be a 14-story structure to cost $950,000.

Chicago Association of Master Steam Fitters, at its annual meeting June 27, re-elected its officers as follows: President, Harry M. Hart; vice-president, F. C. Black; secretary, Charles Glennon; treasurer, B. W. Brady; members of board of directors, C. H. Henrich and G. I. Magan.

Dr. E. Vernon Hill has resigned as chief of the Bureau of Sanitation, Chicago Department of Health, and will devote his entire time to the interests of the E. Vernon Hill Company, 64 West Randolph Street, Chicago, in the manufacture and sale of air testing instruments and other devices used in heating and ventilating work.

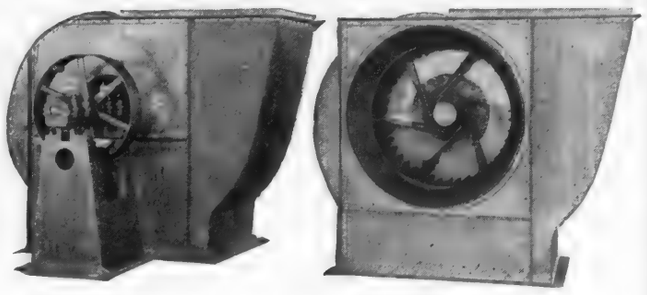
June Building Contracts awarded in the 27 northeastern States, according to the F. W. Dodge Company, amounted to $343,440,000. Except for the record figures of April and May of this year, this is larger than any previous monthly total. It is only 5% under the record May figure, and shows a 52% increase over June of last year.

The continued high rate of activity has brought the total amount of construction started in the first six months of this year up to $1,690,984,000 which is by far the highest figure for the first half of any year. It is 59% greater than the figure for the six-month period of 1921.

In the six months' record are the following items: $682,663,000 for residential construction, an increase of 89% over the corresponding period of 1921; $288,932,000 for public works and utilities, being 19% over last year; $280,329,000 for business buildings, 94% more than last year; $164,641,000 for educational buildings, 58% over last year; and $123,181,000 for industrial plants, an increase of 42 over the corresponding period of last year.

In NewEngland the figures $38,300,000 represented an increase of 16% over the previous month. In New York State and Northern New Jersey the total of $79,383,000 was a decline of 10% from

LEHIGH
MULTIBLADE
FANS



WHERE large volumes of air are to be handled at comparatively low pressures such as in heating and ventilating systems LEHIGH Multiblade Fans are guaranteed to be equal to, if not superior, to any other fans on the market.

A study of the capacity tables and characteristic curves in the Lehigh catalogue clearly proves this fact.

To further substantiate this statement, your attention is directed to the large inlet and outlet, the cone shaped hub, the absence of stay-rods, the rigid construction secured by special blades running tangent from the hub to the periphery of the wheel and also various other details.

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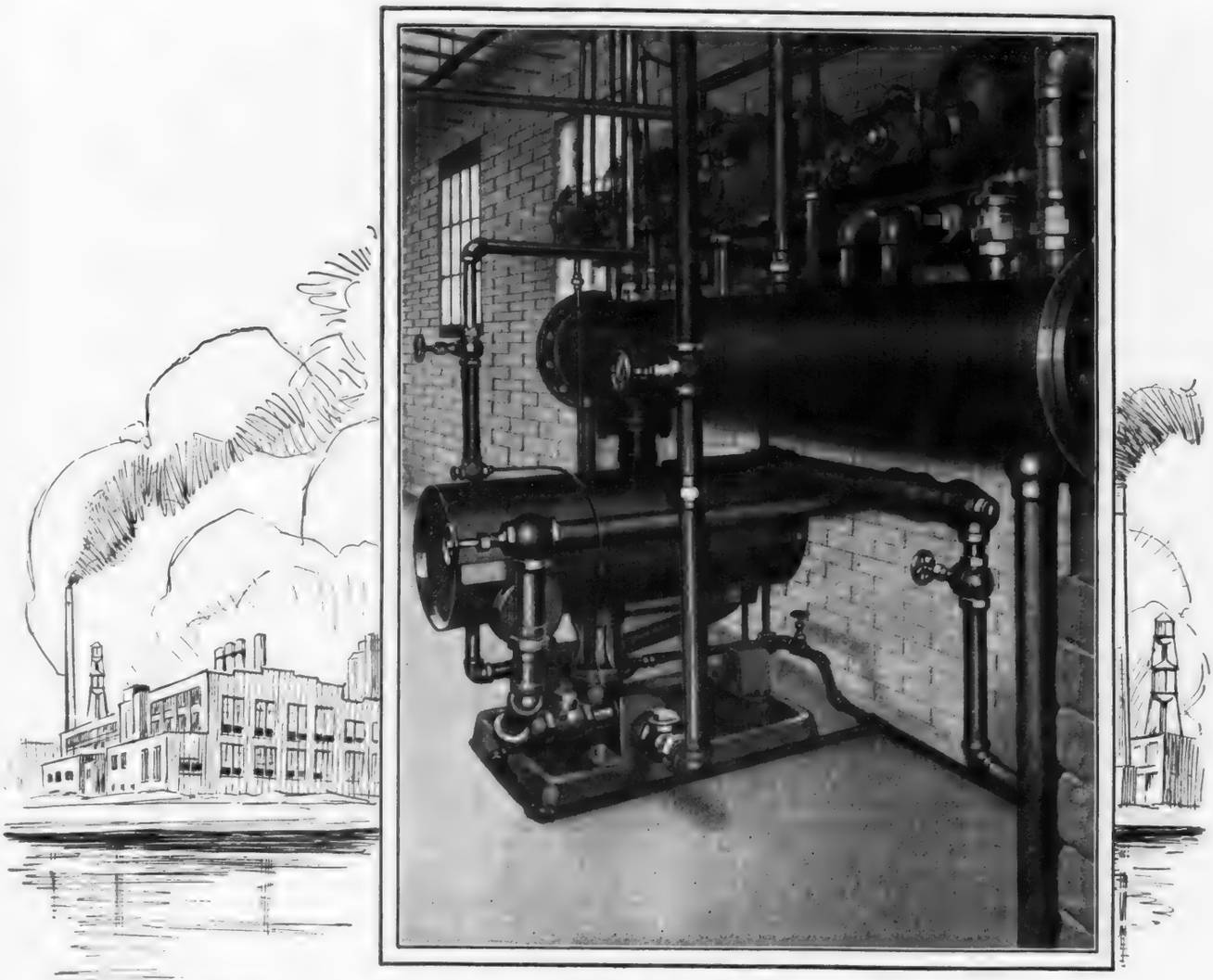

Keeps Heating Systems At High Temperature

Detroit Steam Trap Systems drain steam lines of all condensation, resulting in reduced fuel costs and the maintaining of higher temperatures in heating systems.

By returning the condensation at a temperature of 212 degrees or higher, direct to boilers, without the aid of pumps, Detroit Systems make possible a fuel saving of 15 per cent or more.

If you have a heating problem—a building difficult to heat because of condensation in steam lines—you are assured that the Detroit Trap System will keep that heating system at topmost efficiency. Write today for our booklet in which the Detroit System is described in detail.

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BRANCH OFFICES IN ALL PRINCIPAL CITIES
CANADIAN SIROCCO COMPANY, LIMITED, WINDSOR, ONTARIO

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BLOWERS · EXHAUSTERS · VENTILATING FANS · AIR WASHERS · ENGINES
FOR HEATING, VENTILATING, DRYING, AIR CONDITIONING, MECHANICAL DRAFT

May. In the Middle Atlantic States, there was a slight increase of 3%, the figures coming to $56,373,000. The Pittsburgh district, with $54,454,000, showed a decline of 25% from May. In the Central West, the total of $104,412,000 (1% over the previous month and 74% over June, 1921) is the largest monthly figure for this district since October, 1919. The Northwest also held up well with $10,518,000, a decline of 4% from May but 24% over the figures for June, 1921.

Manufacturers' Notes.

Titusville Iron Works, manufacturer of the Titusville Perfection boilers for power and heating, announces the removal of its New York office to 152 West 42nd Street. M. A. Cordner is manager.

David Fitzgibbons Boiler Corporation, Oswego, N. Y., announces the withdrawal of David Fitzgibbons and D. P. Fitzgibbons from the Fitzgibbons Boiler Co., Inc., which has been reorganized under the new name.

Sterling Engineering Co., Milwaukee, Wis., announces that as the result of a five-weeks' trip through the East by Mr. Goff, vice-president of the company, new branch offices of the company have been established in Baltimore, in charge of William J. Loeber, Home Bank Building; in Philadelphia, in charge of J. B. Freund, 911 Stephen Girard Building; and in Boston, in charge of Daniel L. Hanson, 46 Cornhill Street. These branches will handle the full line of Sterling heating specialties, including themostatic traps, radiator valves, air line valves, vapor and vacuum air eliminators, low-pressure safety valves, condensation pumps, damper regulators, high and low-pressure return traps, strainers, radiator shields and humidifiers.

Garford Foundries Co., Elyria, O., has arranged to turn over its grey iron foundry for the exclusive manufacture of the Bernhard triple-combustion boilers, designed by J. B. Bernhard. Sales offices for marketing this boiler have been opened in Cleveland at 1336 Euclid Avenue.

Trane Co., La Crosse, Wis., manufacturer of the Trane system of vapor heating and other heating specialties, will soon occupy its new building in La Crosse which will add 5400 sq. ft. of floor space to the company's plant. It will be used for the assembling of direct return traps. Another structure is being started at this time to house the company's plating division. Both of these buildings are one-story brick and will be ready for occupancy September 1. The announcement adds: "Yes—they will be warmed by the Trane system of vapor heating."

Wilson Welder & Metals Co., 132 King St., New York, has appointed the King-Knight Co., Underwood Building, San Francisco, Cal., exclusive representative in central and northern California for Wilson Plastic-Arc welding machines and Wilson "Color-Tipt" metals.

Chicago Pump Co., Chicago, Ill., announces that it has secured the services of D. F. Atkins, of New York, to handle the sale of the Chicago pumps in the New York territory. Mr. Atkins, who is an experienced engineer, has established headquarters at 5045 Grand Central Terminal Building, New York. Announcement is also made that a part of the Michigan territory has been taken by the James E. Deegan Company, 242 Larned St., West, Detroit. "They are already proving," writes the company, "that the building boom is anything but a myth. They are willing at all times to offer expert engineering advice on any pump question."

McAlear Mfg. Co., Chicago, Ill., manufacturer of the McAlear line of specialties for steam heating and power plants, announces that it has ready for distribution a new 128-page catalog, known as No. 27, which illustrates a number of new devices, including an individual temperature-control valve, as well as specialties for power plants, vacuum and vapor heating systems, etc., together with illustrations showing their application and use. The individual temperature-control valves is described as self-contained and applicable to any radiator, old or new, without additional piping other than the supply and return. When the thermostat member is set for the desired room temperature, it is arranged to automatically control the opening and closing of the

ALLEN AIR-TURBINE VENTILATOR

Standard of Ventilating Efficiency

Wherever ventilation is desired—in factories, foundries, stores, schools, hotels, churches, theatres, residences, kitchens, bakeries, tanneries, barns, stables, garages, chimneys, air shafts, or wherever air circulation is required. Allen Air-Turbines *have proven the best, cheapest and most efficient* ventilating system known.

Many of America's largest architects, engineers and industrial concerns have adopted and endorse Allen Air-Turbine Ventilators.

Patented

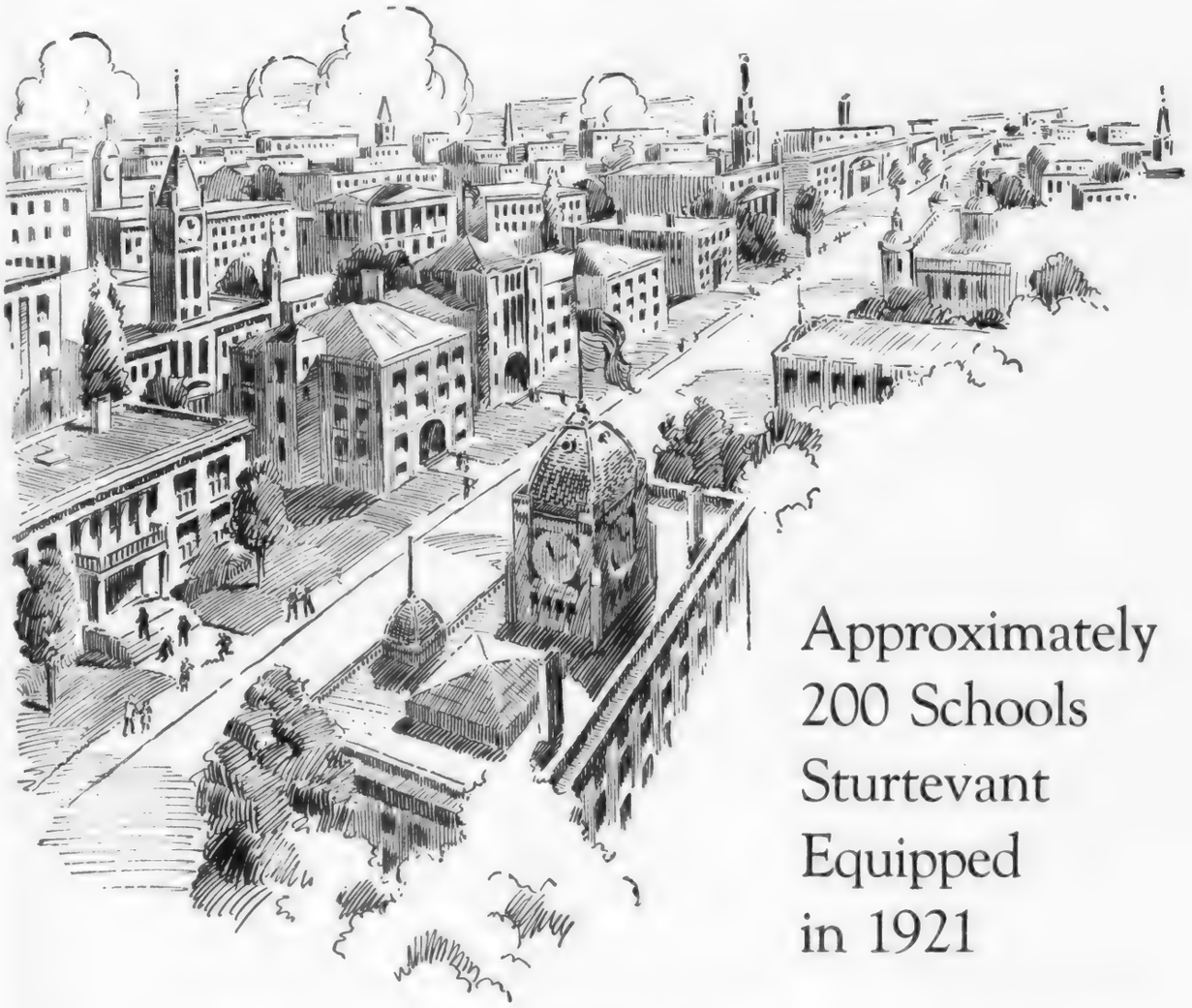
CARRIES OFF
GASES
MOISTURE
STEAM
SMOKE
VAPOR
FOUL AIR
ODORS
HEAT
FUMES
DUST
DAMPNESS

Our air displacement is measurable and the figures given are guaranteed to be correct.

Diameter of Pipe	Air Displacement Cu. Ft. per Hour	
	Wind Velocity 4 Miles per Hour	Wind Velocity 8 Miles per Hour
8 Inches	17,300	21,600
10 "	26,500	32,500
12 "	38,600	46,200
15 "	54,000	69,000
18 "	85,200	102,100
20 "	105,100	125,600
24 "	149,000	185,000
30 "	225,000	272,000
36 "	281,000	330,000
42 "	324,000	414,000
48 "	360,000	473,000

Write for Detailed Literature

ALLEN AIR-TURBINE VENTILATOR CO.
DETROIT **Eighth and Porter Sts.** **MICHIGAN**



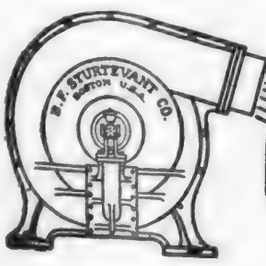
Approximately 200 Schools Sturtevant Equipped in 1921

IN approving Sturtevant apparatus for these 200 schools, the architects knew that the Ventilating systems would operate exactly as desired, because of their faith in Sturtevant data and apparatus.

Further, these schools were in various parts of the country, differing widely in weather and atmospheric conditions and therefore calling for many different requirements of operation.

Sturtevant apparatus has been the accepted standard for schools, since Mr. B. F. Sturtevant, fifty years ago, first applied fans to school-house Heating and Ventilating.

Our engineers are always ready to co-operate with you, without the slightest obligation.



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PUTS AIR TO WORK

HYDE PARK, BOSTON, MASS.

675

valve. The catalogue contains a comprehensive detailed description of all of the specialties listed.

Penn Engineering Co., Philadelphia, has moved its business to Third Street and the Lehigh Valley Railroad where it has purchased a building and plot of land.

Central Station Heating Notes.

Windom, Minn.—At the annual meeting of the stockholders of the central heating plant in Windom, 20% of the outstanding stock was paid off and a dividend declared on all stock. With the present outlook the full amount of stock will be taken up by the company within a period of five years. Under the franchise, when all the stock has been taken up, the heating plant will be turned over to the city free of all debts and thereafter will be operated by the municipality.

San Rafael, Cal.—A voluntary reduction of 15 cents per 1000 lbs. has been made by the Pacific Gas & Electric Company for steam supplied by the corporation to the city for heating purposes at the municipal baths. The new price is $1.05, instead of $1.20 per 1000 lbs.

Dixon, Ill.—Contracts amounting to more than $115,000 have been let by the Illinois Northern Utilities Company on the addition to be built to the new steam plant in the west end of the city. The contracts cover boilers, stokers, transformers, switches, economizers and switchboard.

Bloomington, Ill.—In spite of the fact that the public service commission has not yet rendered its decision on the petition of the Normal Railway and Light Company to substitute steam for hot water in its central heating system, the work of paving the streets has commenced. This work was ordered last year but was held up until now because of the railway and light company's petition. It was contended that if the petition were denied, the company would be required continually to break up the streets to repair the water mains.

DeKalb, Ill.—An order which will provide the users of summer heat in DeKalb with the service at an advance of 98% over that of last year has been issued by the Illinois Commerce Commission and will be effective if nineteen users of the service will sign agreements to use the steam at the advanced rate. The order, which was directed to the Illinois Power Company, states that the company will have to furnish the steam service for steam tables, hot water tanks and other necessary uses at the new rate up to October 1. The steam has been discontinued for some time. The company has expressed its satisfaction with the order and has already arranged to resume the service.

Grand Rapids, Mich.—A plan that may result in the heating from a central plant of the entire business section was outlined by George L. Erwin of the Consumers' Power Company before the service committee of the city commission, July 17. It is proposed to supply new machinery for the old Edison plant on Wealthy Street, S. W., which has been supplying some heat to about 30 customers on Monroe Avenue with its old equipment and insufficient mains. Exhaust steam was utilized from the first. Now, with the general use of the turbine, waste steam, it was argued, has been cut to a point where either the service must be discontinued or new arrangements made to supply the heat, which will be at an excessive rate unless the new equipment can be justified by a wider scope. It is estimated, however, that on the proper scale, this service can be supplied at a rate that will cut the clients' heating costs in two.

The development calls for 20-in. mains to be installed from Monroe up Ottawa Street to Crescent, and on Pearl Street, from Ionia to Campau, also a replacement in part of the old Louis Street main. A franchise is asked for an indefinite period, terminating at the pleasure of the commission, this form being preferred by the power company to one with a definite length, which would require a referendum. The matter of referring the question to the public was carefully avoided by Mr. Erwin, who took the position that the improvement was for the benefit of a comparatively small group and that its chances would be unduly hazarded by an appeal to the comparative indifference of the city at large.

AIR CONDITIONING TRADE MARK

APPARATUS for maintaining artificial atmospheric conditions in industrial plants.

ATMOSPHERIC CONDITIONING CORPORATION
LAFAYETTE BLDG.
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Gauges; Gauge Testers; Steam Engine Indicators; Steam Traps; Feed Water Filters; Recording Thermometers, Pop Safety and Relief Valves; Whistles; Counters and Clocks are backed by 70 years' experience. Write for Catalog No. 70.

American Steam Gauge & Valve Mfg. Co.
Boston, Mass.
Branches in Large Cities

Vento Return Line Valve

for Vacuum and Vapor Heating Systems is a fuel-saver from the moment that it is put to work on the heating system. It never fails in its promise to make the heating system give dollar-for-dollar service for every ounce of fuel consumed. Our latest Booklet, "The Perfect Heating System," will be mailed on request to any heating engineer.

WM. S. HAINES & COMPANY
PHILADELPHIA

Steam Traps Steam Separators Oil Separators Strainers
Air Traps Exhaust Heads Boiler Alarm Water Columns

WRIGHT AUSTIN

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The New York Blower Co.

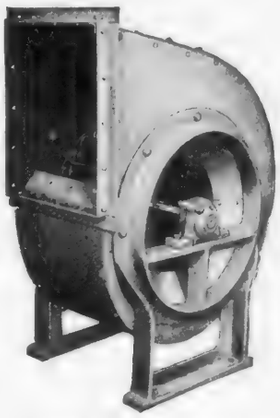
Chicago, Ill. **La Porte, Ind.**

We manufacture a complete line of fan equipment and appurtenances. By concentrating on this one class of products we are able to make them better every year.

Peerless Air Washer

Pulley Driven Disc Fan for Mines

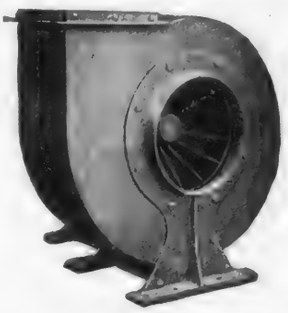
The old fallacy that fan equipment was a luxury is now known to be untrue; it is an economical necessity. We can give actual installations in all kinds of industries where through the wise employment of fan equipment manufacturers have improved the quality of their product, and increased production with a reduction in factory cost.



Type "C" Seri-Vane Fan

If you are interested in drying, humidifying, heating, ventilating, mechanical draft, removal of shavings or similar installations, please communicate with us. If we cannot honestly prove facts to you showing the benefits that will follow from an installation for your special problem, we will frankly so state.

Motor Driven Propeller Fan

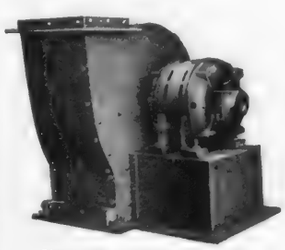


Slow Speed Planing Mill Exhauster

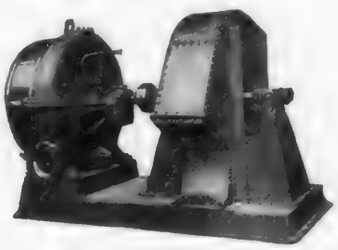
The New York Blower Co.

Chicago, Ill. **La Porte, Ind.**

Branch Offices in Principal Cities



High Speed Type "C" Seri-Vane Fan



High Pressure Blower Direct Connected to Turbine

Stoker Fan

Contracts Awarded.

Charles E. Monday Co., Philadelphia, Pa., heating residence for internes at the Philadelphia General Hospital for $25,960. The plumbing contract went to M. Connelly at his bid of $19,635.

Arthur McKinley, Kansas City, Mo., heating and ventilating Yeager School addition for $17,896. This company also has the plumbing contract at $8,996.

Columbus Machine Works, Columbus, Ind., heating and plumbing new Harrison junior high school for $14,350 for the heating and $3,823 for the plumbing.

P. B. Arnold, Fort Wayne, heating, ventilating and wiring Hoagland, Miner and Clay schools in Fort Wayne for $55,927.

W. S. Patterson & Co., Manitowoc, Wis., heating and ventilating Manitowoc's new high school for $58,636. Other bids were H. P. Reger & Co., Chicago, $68,000; Pharo Heating Co., Madison, $65,729; Downey Heating & Supply Co., Milwaukee, $61,990; American Heating Co., Superior, $63,000; G. H. Kallies, Manitowoc, $65,349.

Sanitary & Engineering Co., Portland, Ind., heating and plumbing Adams County Memorial Hospital at Decatur, for $15,000.

Krause Heating & Plumbing Co., Akron, O., heating and plumbing new school building in Millersburg, O., for $29,742.

G. W. Ensley, Chariton, Ia., heating and ventilating new high school in Chariton. The building will accommodate 600 pupils.

Harrisburg, Pa.—Bids were received as follows for the heating and ventilating of unit C of the senior high school at Sixth and Division Street, Harrisburg: Herre Bros., $67,400; Austin Engineering Co., New York, $79,772; William H. Taylor Co., Allentown, $75,789; Fred P. Merkle, Newark, $80,039.

Fitzpatrick-Hoepfner Co., Columbus, O., heating, plumbing and gas fitting for the Edward Orton High School in Columbus, at its bid of $127,761.

Fall River, Mass.—Bids were received as follows for the heating of the Tuberculosis and the Outpatient and Maternity Hospitals in Fall River: Tuberculosis Hospital, John F. Johnston Co., $54,964; Nathan Miller & Sons, Ltd., $53,335; Lagasse Bros., $55,000; American Plumbing & Heating Co., $50,630; Fall River Steam and Gas Pipe Co., $62,888; T. A. Ridder, Boston, $54,250; McMurrer Co., Boston, $49,675. For the Outpatient and Maternity Hospital the bids were: John F. Johnston Co., $6,995; Nathan Miller & Sons, Ltd., $5,840; Lagasse Bros., $6,500; American Plumbing & Heating Co., $6,298; Fall River Steam and Gas Pipe Co., $8,278.

Van Dyck Heating & Plumbing Co., Des Moines, Ia., heating new $500,000 municipal court building in Des Moines. The building will require 11,000 sq. ft. of direct steam radiation and over 3000 sq. ft. of indirect. A Phelps No. 4268 Kasteel smokeless boiler will be used, manufactured by the Phelps Boiler Works, of Oskaloosa.

G. A. Joles, Maquoketa, Ia., was low bidder, at $31,790, for the heating and ventilating of Maquoketa's new high school building.

Smith Plumbing & Heating Co., Clinton, Ia., Mt. Carroll, Ia., heating and plumbing new high school building in Savanna Township for $27,100.

J. E. Bangs & Co., Sycamore, Ill., heating, plumbing and lighting new school building in Seneca for $44,000.

D. B. & D. E. VanFleit, Garrett, Ind., heating, ventilating, plumbing and wiring new Garrett High School for $17,600.

V. J. Hagen, Sioux City, Ia., heating, ventilating and plumbing new Y.W.C.A. building in Sioux City for $18,975. Other bids were: Orr Co., $20,575; LaVelle & Hogan, $20,375; Sanitary Co., $19,505; Mike Fisher, $19,500; Roney & Son, $21,602.

Pacific Gas Radiator Co., Los Angeles, Cal., heating and ventilating San Bernardino's municipal auditorium for $13,800. A bid was also received from N. Hansen, San Bernardino, for $15,645.

F. W. Webb & Co., Gary, Ind., heating and ventilating five new school buildings in Gary for $14,190, or $2,838 for each school.

Ed. Eastham Plumbing Co., Beaumont, Texas, heating and plumbing three new buildings on the South Park School campus for $66,050.

The Equivalent of Sea Breezes
Clean, invigorating, dust free air containing the proper proportion of moisture is essential to bodily comfort. You will have the equivalent of sea breezes
Right in Your Office
or building, with temperature and humidity under perfect control after you have installed a
TURBO AIR WASHER AND CONDITIONER
This wonderfully efficient unit supplies a steady volume of pure air regardless of outside atmospheric conditions and keeps temperature and humidity practically uniform whether outside temperatures are 40 below or 100 in the shade.
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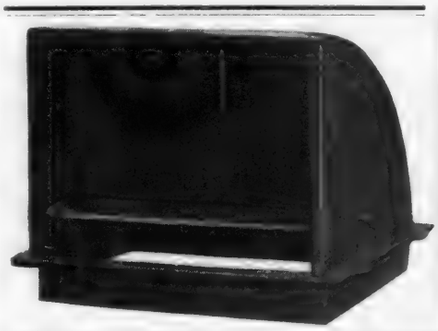

The Knowles Standard Aisle Hood

is made in two sizes 6x8x6 in. high and 4½x8 x4½ in. high.

Made throughout of heavy cast iron (not sheet metal). It has a CURVED REGULATING DAMPER which can be locked at any angle: and permits the easy flow of the air without friction loss.

The
KNOWLES STANDARD AISLE HOOD

is an AIR DEFLECTOR used in auditoriums of theatres, schools, churches under the aisle seats only to throw the fresh air out into the aisles in one direction.

It is an inexpensive method of introducing a large volume of air without the possibility of a draught being felt.

Also Manufacturers of
The "Camelback" Air Diffuser
and
The Knowles "Notch" Mushroom Ventilator

Send for blueprints and prices

Knowles Mushroom Ventilator Co.
202-204 Franklin St. New York City

Westinghouse

THE selection of Westinghouse Motors for the Ventilating fans in the new Bankers Trust Company Building of New York is in keeping with the high standard of equipment used throughout the structure.

The motors, built from duplicates of long tried standard designs, are highly simplified in design and construction.

Their operation is quiet, constant and reliable. They require little care or attention and they are built of materials that give years of service at their rated capacity.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.

East Pittsburgh, Pa.

Offices in all Principal American Cities

THE DOUGLASS HUMIDIFIER

STANDARD TYPE
Made in three sizes for direct connection to steam piping

Is attached directly to the steam heating system

Discharges dry steam noiselessly

Gives satisfactory results in any type of building equipped with steam

Inexpensive to install

Will not get out of order

No attention required

No maintenance expense

Made in various sizes and types to suit all conditions and requirements

Illustrated catalogue sent on request

THOMAS J. DOUGLASS & CO.
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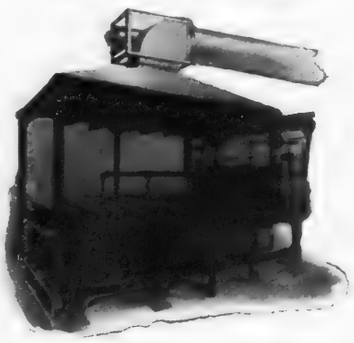
RADIATOR TYPE
Is attached to steam radiator in place of the air valve. Made in one size only.

For One Concern We Figured A Saving of 48 H. P.

by substituting 25 *Wing-Scruplex Exhausters* for 25 exhausters of another type.
You could do the same for your clients with

THE WING-SCRUPLEX REG. U.S. PAT. OFF. EXHAUSTER



The *Wing-Scruplex* exhauster shown here is exhausting *5,000 CUBIC FEET* of air-smoke-fumes-per minute with *ONLY ONE HORSE POWER.* Compare this with the performance of other exhausters.

L. J. Wing Mfg. Co.

Fans and Blowers
Small Turbines
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MASSACHUSETTS DAVIDSON PROPELLER FANS

Are especially suitable for handling large volumes of air at low resistances.

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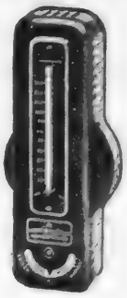


The Powers Thermostat "K" as used on Factory Installations.

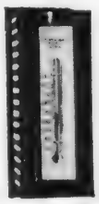
The Powers Thermostat

You Will Always Find It Ready
Put In Powers and Forget It

BUILT on the vapor disc principle—the heart of the Powers System of Temperature Regulation—its sensitiveness to thermal changes is as immutable as the underlying principle of mathematics.

Put in POWERS and forget it. You will find it just as ready to give accurate service when the heat is turned on in the Fall as it was all the Winter and Spring before.

Cheapest in cost per year—highest in service and satisfaction.



The Powers Thermostat "D" as used on Residence Installations.

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(1771A)

THE IMPACT AIR WASHER

Comprises a number of important features.

Highly Effective Dust Removal

The "Impact" Washer is guaranteed to remove 95 per cent of such dust as is found in ordinary city air. Extra-intimate contact of air and water is effected by the use of nozzles of our "Impact" type which due to their special construction and arrangement produce a dense and uniform mist or spray.

Uninterrupted Service

The "Impact" type of nozzle produces a flat, fan-shape spray by the impact of two jets from large smooth orifices, there being no internal spirals or passages whatever to become clogged with sediment. For the further prevention of plugging our special scale arrester is placed just back of each spray head. This arrester with its numerous holes each slightly smaller than the nozzle orifices, intercepts and retains all bits of sediment and scale which would not pass the nozzles. The accumulation on this strainer is slow and is quickly removed while washer is operating.

Other exclusive features. Ask for Booklet K.

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Many styles for many kinds of service. Low pressure Fans that deliver immense volumes of air at low velocity.

Cone cased Fans for higher pressures, Extreme Fans for high pressure and high velocity.

Compound Fans from 11 feet in diameter to 24 feet in diameter for Mine Ventilation.

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SEYMOUR FANS are not an experiment. Over 100,000 now in service. Built of the best materials. Good Workmanship. Commercially Attractive Prices.

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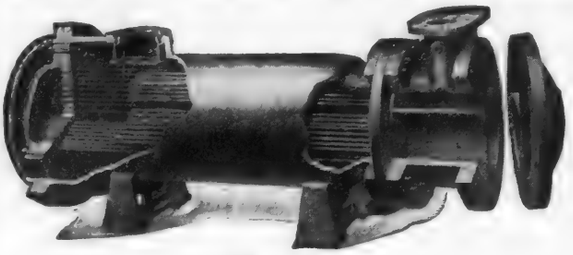
The solution of the hot water problem



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INSTANTANEOUS HEATER

Hot water on tap all the time—instantaneous service! Uses either live or exhaust steam. Has the highest heat transfer factor of any closed water heater on the market. Most compact construction. *It's economical.*

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Heating and
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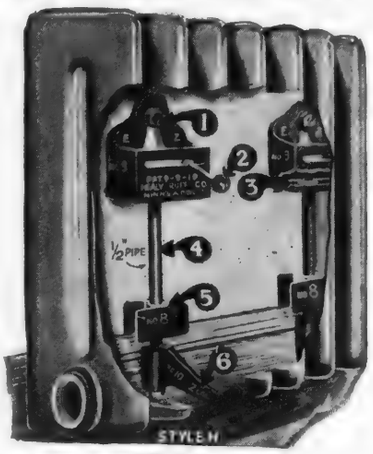
of
E-Z
RADIATOR HANGERS



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1. One Bolt
2. Invisible Washer
3. Horizontal Adjustment
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5. **Adjustable for Baseboard**
6. Made for Wall, and Column Radiation

STYLE R
Without Baseboard Adjustment
Reasonable Price

Made for all styles of radiation

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Manufactured by
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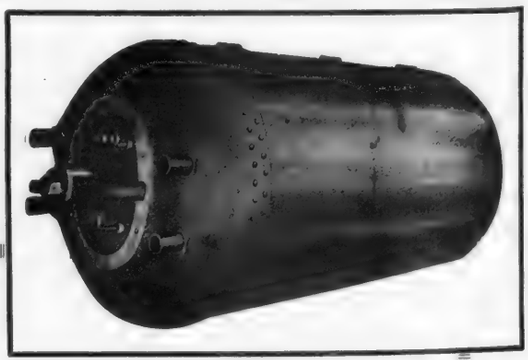

For Durability
For Service
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For Personal and Client Satisfaction

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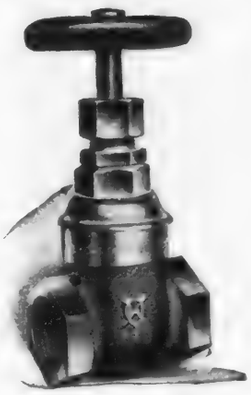
Dahlquist Copper Boilers

Dahlquist Manufacturing Company
40 West. 3rd St. Boston, Mass.

KENNEDY VALVES

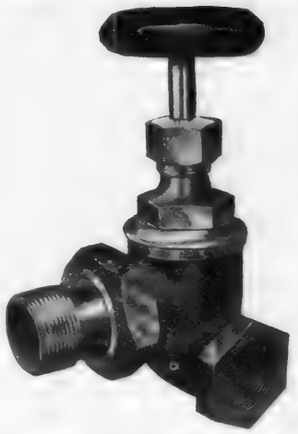


The Test of Valve Quality

is the length of time the valve continues to render the most efficient service without giving trouble or entailing expense. There are Kennedy Valves of the long time kind all over the United States and Canada.

These Kennedys are doing good work in every variety of valve service, and a considerable proportion of them are on high and low pressure heating system lines.

The experience of thousands of users of Kennedy Valves have given the Kennedy product a reputation for durability, reliability, and efficiency of which we are justifiably proud and that we conscientiously strive to maintain.



You can be sure that every Kennedy Valve you install will be *permanently* satisfactory in every way. The Kennedy Catalog explains the details of design and construction that assure easy operation, low repair cost, negligible attendance and unusual durability. Send for a copy and use it to help make a selection of Kennedy Valves for trial.

250

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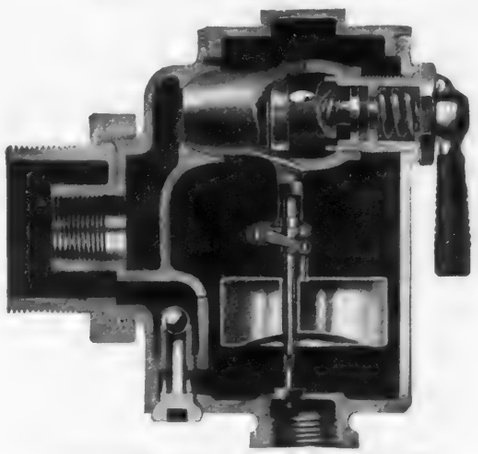

Cross Section of the Vacuum, Vapor and Low Pressure Dual Valve.

1. The Dual Valve permits no steam to enter return pipe.
2. Free air exit at all times regardless of the position of return valve.
3. Requires no eccentric or other bushings.
4. The Dual Valve replaces both the ordinary trap and graduated supply valve.
5. The operation is controlled by condensation—a natural element.
6. *The Dual Valve is the absolute elimination of all trap troubles.*

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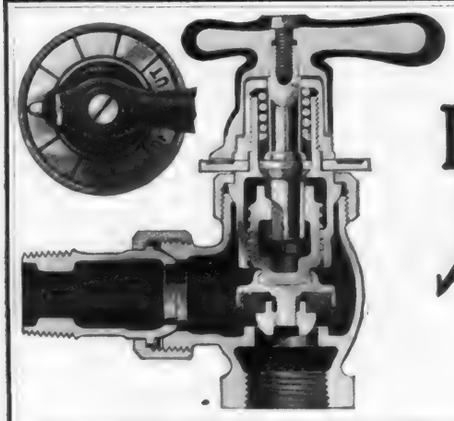

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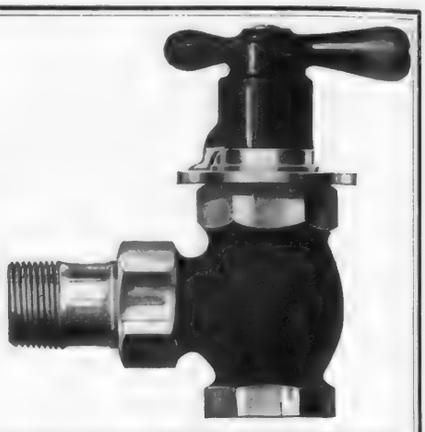
RE-ENFORCED
MODULATED
VALVES



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Nothing like it in Modulation valve handle construction, giving the same seating force in closing valve and smoothness of operation as with a wood wheel, completely doing away with side strain and necessity of having to reach over or around valve to operate same.

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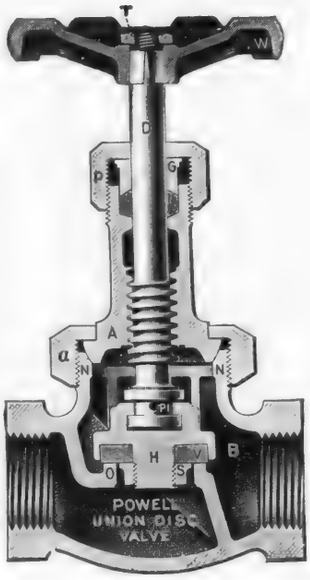

UNION COMPOSITE DISC VALVES

ALWAYS DEPENDABLE

For Hot Water or Steam Heating

Notice the Union Bonnet Connection

Ask your dealer for Powell Valves

The Wm. Powell Company
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CAPITOL PACKLESS QUICK OPENING VALVES

Have opposing seats.

Can be used on either pressure or vacuum systems.

Perfect in every detail.

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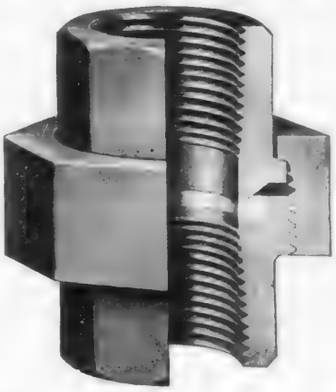
SIMMONS' MALLEABLE BRONZE SEAT UNION

The UNION You Have Been Waiting For



This UNION has a bronze metal immovable ring seat.

Corrosion and rust do not affect it.

Has no iron-to-iron contacts.

No union, regardless of weight, in actual use or test, will stand greater pressure or strain.

The joints are ball shape and ground to fit.

PERFECT CONTRACT OF ENTIRE SURFACE NO GASKETS OR LEAD NEEDED
Designed for Working Pressures up to 250 Lbs.
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All Sizes in Stock from 1/8" to 3" Prices on Request

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The Sterling Slide Valve Return Trap

Patent applied for

Will thoroughly drain return lines of heating systems, eliminate air without loss of vapor and return water to the boiler against pressure.

It will lift liquids to a higher level where steam or air pressure is available.

It can be placed as low as 3 inches above the water line of the boiler, thus making it possible to install vapor systems in basements with low ceilings.

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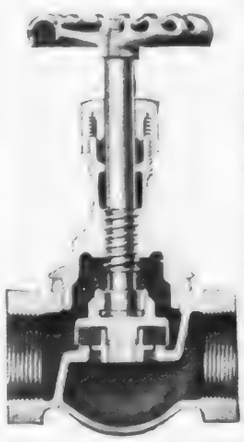

Sectional view Fig. 106, Jenkins Standard Brass Globe Valve, fitted with Jenkins Renewable Disc.

SUPERIOR service of Jenkins Valves is dependent on two component parts: the valve itself and its disc. The best or true Jenkins service can be expected only from genuine Jenkins "Diamond Marked" Valves, fitted with discs that bear the same distinguishing mark.

To make sure of perfect valve performance — first, use genuine Jenkins Valves, and, second, when you renew a disc, use a genuine Jenkins Disc.

At supply houses everywhere.

JENKINS BROS.

New York	Boston
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Jenkins Valves
SINCE 1864

These **BIG TEETH** *mean* **LONG WEAR** *for*

S&B Columbia Gauges

Compare the gear teeth in these two pictures and you will see why the segment and pinion of S & B Columbia Gauges outwear other makes.

S & B Columbia segment and pinion have *long, thick gear teeth with big engaging surfaces; while ordinary gauges have short, thin teeth with small contact surfaces.*

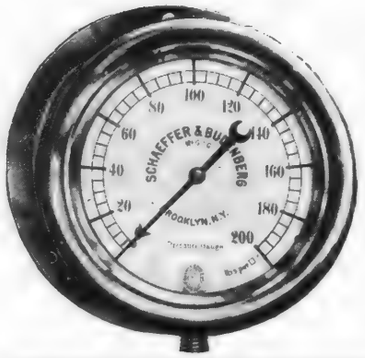
Short, thin teeth, meshed lightly with teeth of the same character, simply can't stand up against the constant oscillation and wear to which a gauge movement is subjected. It is just such teeth that cause ordinary gauges to record inaccurately and break down before their time.

Also note how carefully the pinion and segment in S & B Columbia Gauges are adjusted in order that they do not come together too tightly nor too loosely. This explains why S & B Columbia movements do not stick—why there is no friction.

These are only a few of the many perfections in S & B Columbia Gauges. Every refinement that mechanical brains and ingenuity can devise to insure accuracy and durability has been embodied in these finely built gauges.

You will be interested in our Gauge Book A-14 Write today for a copy.

THE Schaeffer & Budenberg MFG. CO.



Makers of Columbia Recording Thermometers and Gauges with "Time Punch"

BROOKLYN, N. Y.

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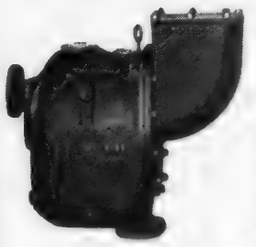
Handling Condensate

Dunham Return Trap



In buildings of moderate size, janitors or firemen frequently have other duties besides the care of the heating plant. As a rule, pressures are permitted to vary over a considerable range. The Dunham Return Trap proves a very necessary addition to such an installation.

Principle of Operation: Fills with condensate; steam valve opens, air valve closes, equalizing pressure between boiler and trap; condensate flows back to boiler by its own weight, emptying trap; steam valve closes, air valve opens, permitting free vent of air from radiators as condensate accumulates.

Especially designed for low pressure heating service. Three sizes, capacities 3,500 to 10,000 square feet direct radiation. Complete data on request.

C. A. DUNHAM CO.

230 East Ohio Street, Chicago
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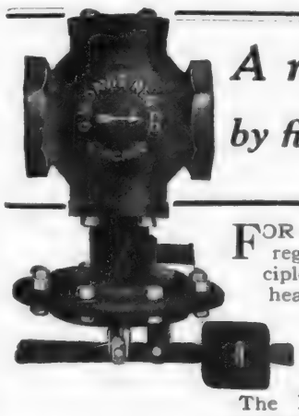
The DUNHAM REG. TRADE MARK HEATING SERVICE



A regulator proved by fifty years of service

FOR almost fifty years—since 1874—regulators employing the Davis principle have given reliable reduction in heating systems. Other regulators using different principles have come and gone, but time has proved that the design of the Davis is *right*.

The Davis has no springs—no diaphragms—no toggles—no packing, just a finely balanced inner valve. It requires less attention, lasts longer, and gives steadier, more accurate pressure reduction. You can get Davis Regulators at the lowered prices listed below. Write the G. M. Davis Regulator Co., 436 Milwaukee Avenue, Chicago, for details of the money-back guarantee.

Ask for Description of Davis—

Water Control Valve
Back Pressure Valve
Balanced Valve
Stop and Check Valve
Flow Regulator
Fluid Level Controller
Float Valve
Steam Trap
Relief Valves
Non-Return Valve

Size Inches	Price	Size Inches	Price
¾	$22.50	2	$35.00
1	25.00	2½	42.50
1¼	27.50	3	50.00
1½	30.00	4	70.00

DAVIS VALVE SPECIALTIES
STEAM SAVERS SINCE 1874

HORNUNG PRESSURE and TEMPERATURE CONTROL VALVES

Style P. & T. Fig. 3

MASTER CONTROL

The MASTER CONTROL was designed, and is especially adapted, for control of steam heat as served from a Central Heating Plant.

The MASTER CONTROL is a combination of two valves in one, in which the lower diaphragm operates to control the pressures while the motor mounted on top of the valve operates to close off the steam when no heat is required in the building.

These valves are made interchangeable so that the MOTOR DRIVEN TEMPERATURE CONTROL may be attached to the PRESSURE CONTROL at any time.

The temperature control is also furnished without the pressure control diaphragm.

The MASTER CONTROL valve has been in use for twelve years and the saving it brings to the customer is clearly a matter of record.

A 30% reduction in the meter bill is a conservative average.

CENTRAL HEAT APPLIANCES

343 South Dearborn Street J. C. HORNUNG CHICAGO, ILL.

The Honeywell Heat Generator

is the heart of the Honeywell Hot Water Heating System, giving absolute control together with a range of temperature from 85 to 240°. Compare this remarkable flexibility with the 212° to 220° of a good steam system or the 150° to 212° of a good vapor system.

The universal success, the never disappointing years of operation of the HONEYWELL SYSTEM have proved conclusively that the theory upon which it is based is correct. An increased and positive circulation; an instantaneous heat under perfect control, quickly increased or checked; the use of smaller valves and piping, with less water to move; the sending of even heat into radiators at extreme distance from boiler; minimum amount of piping; an easy layout for the fitter and the minimum cost of installation and operation.

Tank-in-attic or Tank-in-basement layouts as desired.

Years of use and thousands installed in the United States, Canada and other countries have proved its superiority.

Helpful Engineering Service supplied.

Our booklet "How to Properly Design and Install the Honeywell Method of Hot Water Heating" tells the whole story and will be mailed on request.

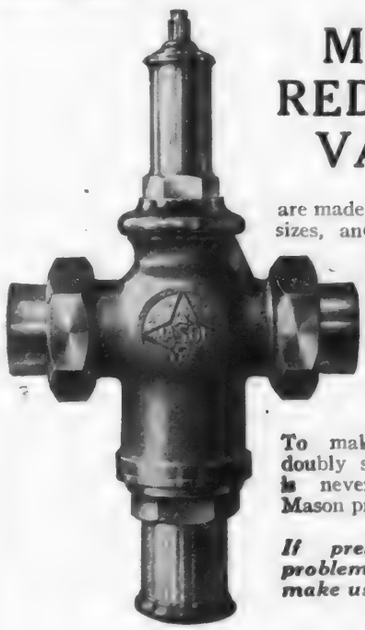
The Honeywell Heating Specialty Co.

WABASH, INDIANA

Manufactured in Montreal for Canadian Trade

By Repute "Always" Reliable

Mason Reducing Valves have an extraordinary reputation for three things—long life, continuous service and reliability, which is, after all, only a natural tribute earned through merit.



MASON REDUCING VALVES

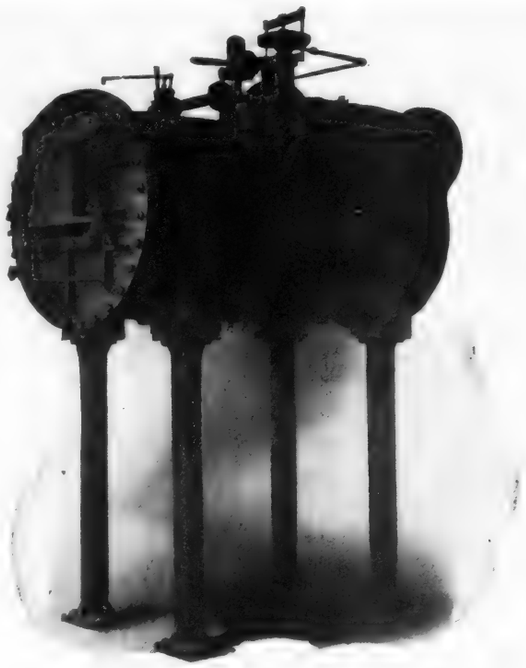
are made in many types and sizes, and every type and every size can be depended upon to reduce and maintain pressure at the proper delivery point, regardless of the fluctuation in the initial pressure.

To make your assurance doubly sure, Mason service is never separated from Mason products.

If pressure regulation problems trouble you, make use of our service.

MASON REGULATOR COMPANY

Boston, Mass. San Francisco, Cal. Montreal, Canada



This is an Elliott Deaerator

This compact unit, together with a small Heater, Pump and Auxiliary Condenser, with a rated capacity of 2,000 gallons per hour accomplishes the removal of oxygen and dissolved gases down to .1 cc. per liter. This unit is now operating in the basement of the Weightman Building, Philadelphia, Pa.

Deaeration of the supply water by the Elliott method puts an end to the corrosion and rusting away of hot water piping. By experiment and practical test, it has been proven that air dissolved in the water is the primary cause of piping corrosion. Rusting can get in its destructive work only in the presence of oxygen. Removing the dissolved air from the water before it enters the piping extends the life of the piping system to that of the building itself.

Deaeration is able not only to stop corrosion, but it will gradually clear out the rust from choked pipes.

Can you afford not to investigate this piping protection and insurance?

Elliott Company

Pittsburgh, Pa.

General Sales Office: Fourth Street, Jeannette, Pa.

District Offices: New York, Chicago, Philadelphia, Boston, Cleveland, Cincinnati, Detroit, St. Louis, Kansas City, Pittsburgh, Syracuse

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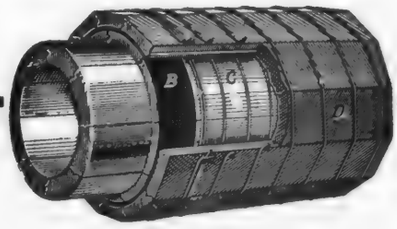
ELLIOTT

De-aer-ated water can't rust

Deaerator



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Cover Your Steam Pipes with

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Improved
Cypress Covering

Not affected by wet and dry conditions common to steam-pipe trenches. Will not rot. Absolutely water and steam tight. Each shell is wound with extra-heavy steel wire. Coated all over with the best known preservative—**Montezuma Asphalt.**

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FOR UNDERGROUND STEAM OR HOT WATER PIPES

THE ORIGINAL **RIC-WIL** METHOD

embodies more original ideas, more advanced engineering, and more good practical features than any other system on the market. The material, construction, installation methods and practical results which, combined, form what we call the RIC-WIL Method, appeal with equal force to the engineer, to the practical operating man and to the business executive. Let us send you a copy of our descriptive Bulletins 1-3. Write to-day.

The RIC-WIL COMPANY
CLEVELAND

Banner Rock Wool Jacket

100% Fireproof

Hot Surface Insulation

PURDUE UNIVERSITY at Lafayette, Indiana, made tests to determine relative transmission of various Heat Insulations. The results obtained are as follows:

Material	Heat Loss in BTU's per sq. ft. per deg. difference, per 24 hrs.
1" Rock Wool Jacket	4.886
1" Hair Felt	5.34
1" Rock Cork	5.623
1" 85% Magnesia	6.842
1" Asbestos Sponge Felt	7.104

Is Not Our "Jacket" Worth Investigating?

BANNER ROCK PRODUCTS CO., Alexandria, Ind.

QUALITY HEAT AND COLD INSULATION

$34.20 COMPLETE

Price is net.

Sold with an absolute guarantee.

We also make a regulator for higher pressures. Also, Reducing Valves; Pump Governors; etc.

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VICTOR Damper Regulator

For Boiler pressures up to 25 pounds.

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REGULATING VALVES FOR EVERY SERVICE

281 South Street Newark, N. J.

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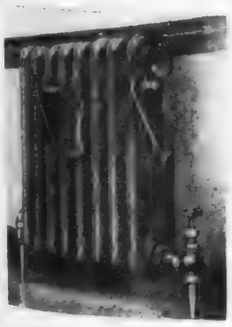

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LABOR SAVED
NO WALL STRIPS
NO BREAKAGE
NO DIRT
INEXPENSIVE

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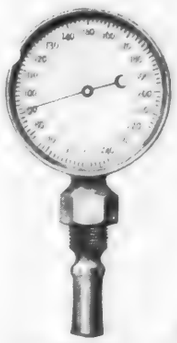
Sheet Metal Constructors

985 Dean St., Brooklyn, N.Y.

DEPENDABILITY!

SYNONYMOUS WITH STANDARD "Metallic" THERMOMETERS



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PRACTICALLY INDESTRUCTIBLE
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WARRANTED ACCURATE

Standard "Metallic" Thermometers are built for long and reliable service—backed by our experience of nearly forty years as Thermometer Manufacturers—made in INDICATING or RECORDING type, with ANGLE or STRAIGHT STEM. Write us about your requirements or send for descriptive booklet. We have a variety of sizes and models from which you can select your STANDARD "Metallic" THERMOMETERS.

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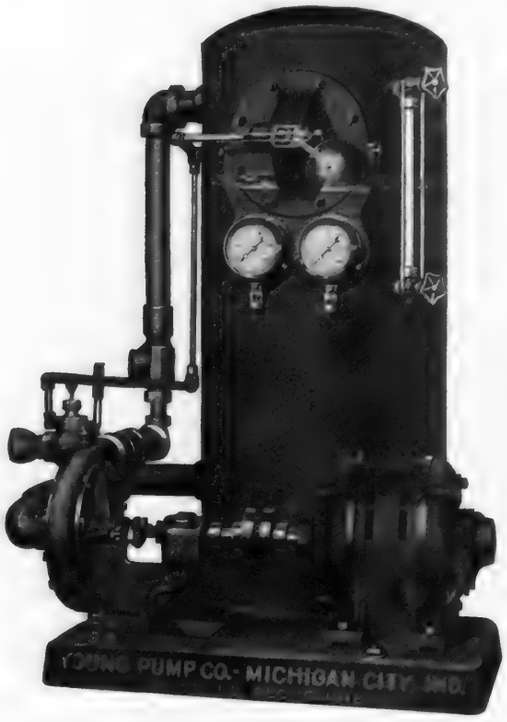
Clifton St., Boston 19, Mass.

Nearly Forty Years as Thermometer Manufacturers



They Come This Way!

JUST as you see the "YVM" outfit in the above illustration—that is the way the Young Centrifugal Vacuum and Boiler Feed Outfits are shipped. *Complete in every detail!* When received on the job, it is only necessary to make pipe connection to the system and boiler and wire connection to the motor. Then all is ready for operation.

The "YVM" is the simplest outfit made. There are no valves, springs or other parts that require adjustment, wear out or cause repair expense. It has a very low maintenance cost—in fact, the outfit is *economical in every way*.

Made in six sizes to handle 4,000, 8,000, 16,000, 26,000, 40,000 or 65,000 sq. ft. of radiation; for continuous operation or automatic control, to meet any condition or pressure.

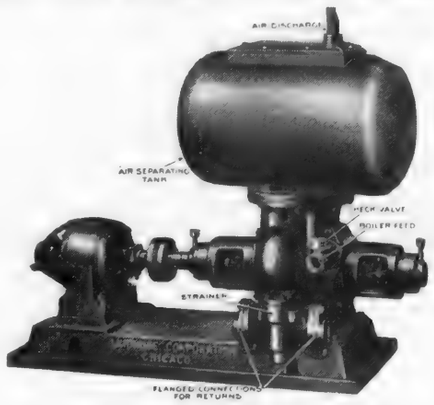
Young Pump Company

Michigan City **Indiana**

Chicago Office, 327 S. Lasalle St.

Skidmore Hydro Turbine Vacuum and Boiler Feed Pump

The latest development in an electrically operated device for this purpose. Quiet in operation. Constant efficiency. Simple design. No close clearances on moving parts. Minimum floor space occupied. Everything on one base. Ease in installing. No piping necessary, just connect to returns. Bronze fitted throughout. Ball bearings.



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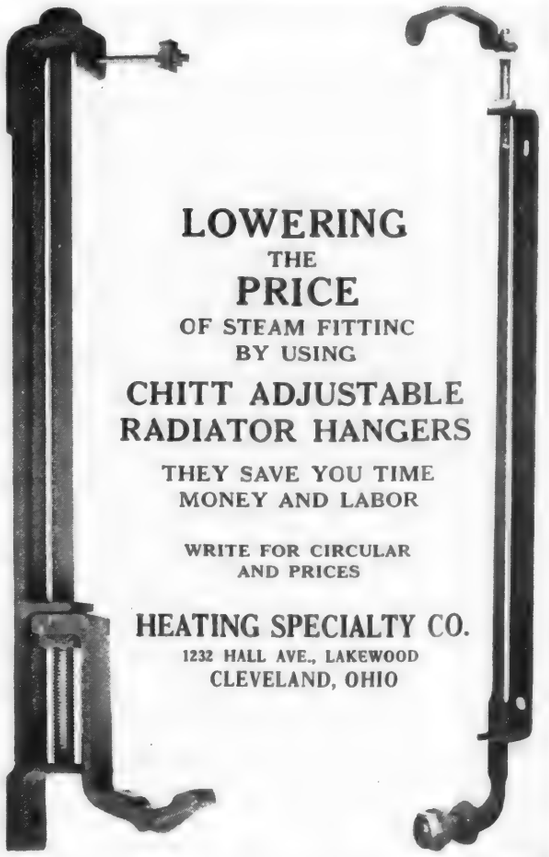
1535 Dayton St. CHICAGO, U. S. A.



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OF STEAM FITTINC BY USING

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THEY SAVE YOU TIME MONEY AND LABOR

WRITE FOR CIRCULAR AND PRICES

HEATING SPECIALTY CO.

1232 HALL AVE., LAKEWOOD

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PATENTED PATENTED

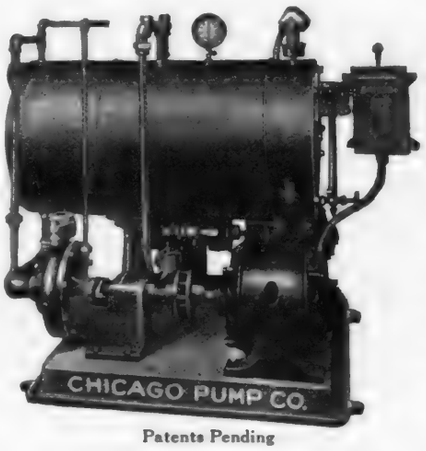
CONDO-VAC RETURN LINE PUMP

CONDENSATION-VACUUM PUMP

A return line vacuum pump, like any other pump, is designed for efficiency and economy. A pump that is wasteful or one that is constantly in need of repair is money and time lost.

Our Condo-Vac return line pump is designed and made of such materials that it will stand up under the most distressing and unusual circumstances as well as under easy operation terms.

True efficiency in a Return Line Vacuum pump can be obtained only with a CONDO-VAC because—air and water are handled by separate pumps, each driven by its own motor and each controlled independently, eliminating the waste in electricity and wear on machinery.



Patents Pending

Each pump operates only when there is actual need of its services.

Since air and vapor are approximately four-fifths of the volume handled, there is no need of running the water pump four-fifths of the time unnecessarily. These are some of the many reasons which makes the CONDO-VAC especially desirable.

THE ABOVE ADVANTAGES OF THIS PUMP ARE BUT A FEW OF THEM. SEND FOR BULLETIN 45 AND SEE THE OTHER ADVANTAGES FOR YOURSELF.

CHICAGO PUMP COMPANY

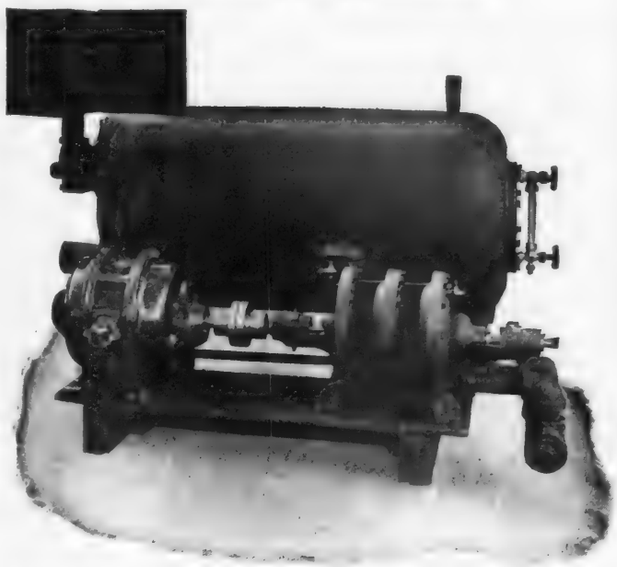
2325 WOLFRAM STREET CHICAGO, ILLINOIS

YEOMANS

ELECTRICALLY OPERATED

CONDENSATION RETURN PUMPS

HORIZONTAL AND VERTICAL



SPECIAL TYPE H HIGH PRESSURE UNIT

RUGGED RELIABLE

Constructed to insure long life.

Superiority proven by years of experience.

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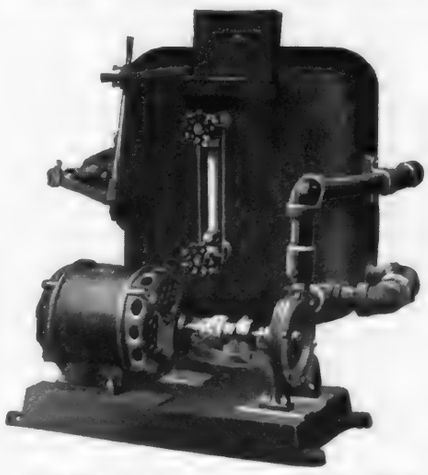
YEOMANS BROTHERS CO., 1421 Dayton St., Chicago, Ill.

Canadian Representatives Darling Bros., Ltd., Montreal

WESTERN AUTOMATIC ELECTRIC CONDENSATION PUMP and RECEIVERS



RELIABLE SIMPLE

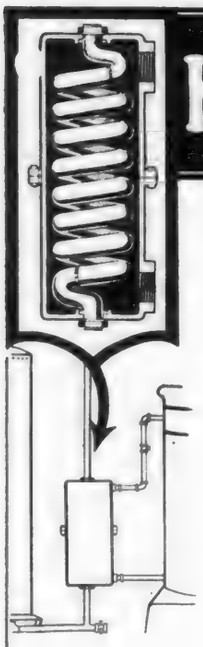
A single stage pump suitable for high or low pressure ranging from 10 lbs. to 100 lbs.

The unit is very compact, mounted on cast iron base, only two pipe connections necessary when installing. The receiver is made in two sizes, of heavy cast iron. An enclosed butt contact switch is used on all pumps.

Write for Bulletin No. 220

WESTERN ENGINEERING CO.

DAVENPORT, IOWA



PLENTY OF
HOT WATER
NO EXTRA EXPENSE

The most approved and economical method of heating water for domestic purposes. An abundant supply of hot water at just the right temperature, 24 hours a day, at practically no extra cost. Easily connected to outside of steam, vapor or hot water boiler; does away with fuel-wasting coil in fire pot, uses surplus heat of boiler. Does not overheat or underheat. Will not burn out, once installed.

An unusual opportunity for live dealers. Order now and be prepared for the demand being created. We furnish cooperation and practical sale helps to give you full benefit of our national advertising. Write for full details.

The Hotstream Heater Co.
"Makers of Heaters that Heat"
Cleveland, Ohio

The **Hotstream**
INDIRECT WATER HEATER

We also make a complete line of Gas and Kerosene Water Heaters.

Solved!

—a problem architects and engineers have vainly studied for years

Twin-Fire has solved the smoke problem. Through the combustion of volatile gases by means of the twin-arch principle, this stoker makes possible a hotter fire, a more flexible furnace and a more economical power and heating plant!

Twin-Fire
HAND STOKER
"It Burns the Smoke"

Stops Smoke—Saves Fuel

Will burn any grade of coal, and on installation over the ordinary setting, will save 10-30% fuel. Eliminates dirty tubes. For installation under boilers from 50 to 1000 H. P. Found today in nationally-known office and industrial buildings,—*and making good wherever found!*

This Book Explains the Solution

By means of a series of tinted cross-sections, it explains in simple terms the Twin-Fire process of combustion. Full of figures and data. Handy size for files.

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1251 First National Bank Building
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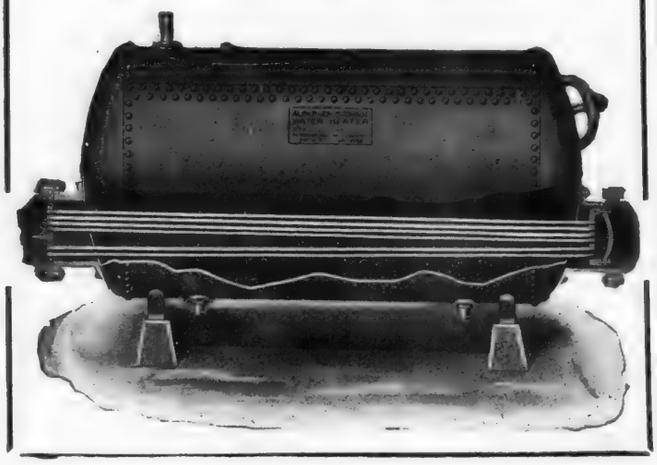
"Successful Furnace Builders Since 1898"

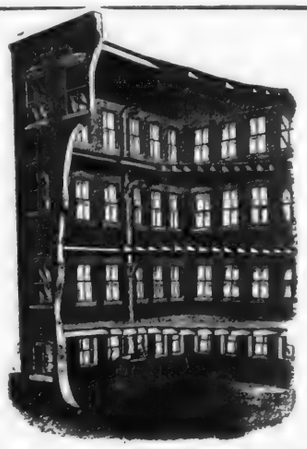
SEND FOR IT TODAY!

Reducing Hot Water Costs
WITH
ALBERGER
(Buffalo)
HEATERS

A plentiful hot water supply will always be available at the minimum cost. Let us tell you how it is done.

Alberger Heater Company, Buffalo, N. Y.





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Adapted for heating and ventilating large buildings. No need of distributing pipes. Takes full advantage of the laws of nature in the production of warmed air and utilizes these laws in providing an even distribution of warmth and comfort throughout the largest of buildings.

Sales representatives wanted

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Surface Barometric and Jet Condensing Equipments for Power Plants.
Main, Auxiliary, Distilling Condensers & Evaporators for Marine Service.
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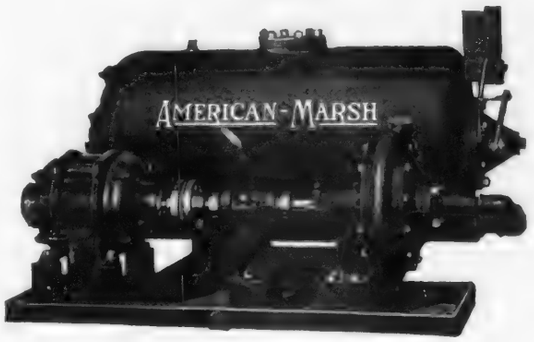
"Crosshead Guided" Expansion Joints
Ross Boiler Feed Water Heaters.
Ross Oil and Sugar Juice Heaters.
Gravity & Forced Circulation Heaters.
Ross Oil, Air and Water Coolers.

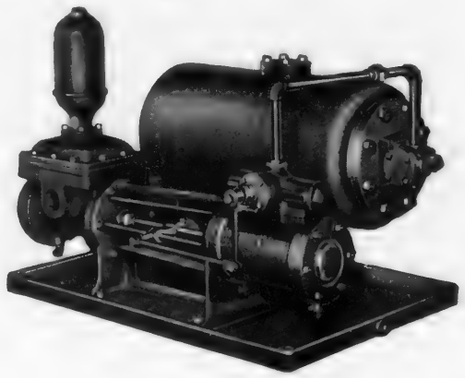
ROSS HEATER & MFG. CO., Buffalo, N. Y.

THE BRAND THAT LEADING ENGINEERS DEMAND

American-Marsh Condensation Pumps

Direct Acting and Centrifugal





American-Marsh Condensation Pumps are the result of over thirty-five years experience in the manufacture of high grade pumps for heating systems. They are built in the motor driven centrifugal type in both horizontal and vertical patterns, the vertical type being intended for use where the returns are laid on or under the basement floor.

The steam driven pattern is equipped with the well known American-Marsh steam valve, the same as used on American-Marsh Vacuum Pumps. With this type of valve the pump positively cannot short-stroke or race. Steam pumps can be furnished to operate on steam press ures as low as 10 pounds. On pressures lower than this the motor driven type is recommended.

May we send you our interesting booklet covering pumps for heating systems?

AMERICAN STEAM PUMP COMPANY, Battle Creek, Mich.

BAILEY METERS

BAILEY FLUID METERS record and totalize the flow of steam at any pressure or temperature, boiler feed, condensate, circulating water, or, practically any fluid flowing in a pipe. These meters are ideal for the measurement of low pressure steam as used for heating, because pressure and temperature records may be included on the same chart, giving the complete story of the steam supply. This makes it possible to calculate the actual B. T. U. supplied to a customer, and is conclusive evidence in case of any question regarding the supply. The pressure compensator has been in service for some little time. This device automatically corrects the totalizer readings for pressure changes, so that actual steam flow may be read directly from the meter.

BAILEY BOILER METERS accomplish more real results toward obtaining maximum efficiency and capacity from boiler operation than all other meters or instruments combined, because they record rate of Steam Flow from the boiler, the Rate of Air Flow through the furnace, and the Flue Gas Temperature on a single uniformly graduated chart. The Steam Flow shows the rate of steam production. The Air Flow shows the amount of air supplied for the support of combustion. The relation between these two records shows an excess or a deficiency of air supplied for the support of combustion. The Flue Gas Temperature is a sure indication of the condition of baffles and heating surface when considered in conjunction with the other records. Wind Box Pressure and Stoker Speed as well as a totalizer for the Steam Flow may be added.

BAILEY WEIR METERS record and totalize flow of water or other liquids through V-Notch weir and are used for feed water, hot well discharge or other fluids at or near atmospheric pressure.

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BAILEY METER COMPANY
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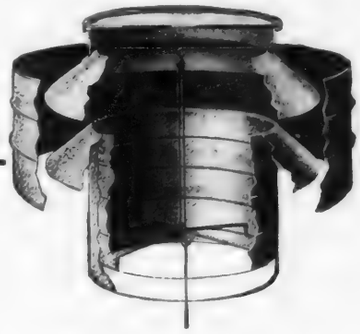

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THE BURT GLASS TOP VENTILATOR

a combination ventilator and skylight in which the light is never obstructed or shut off, no matter how much or how little ventilation is required. A stationary ventilator with the sliding sleeve damper—an exclusive feature. Enormous pulling power. Storm proof and manufactured in any size required.

Send for 128 page catalog showing installations.

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261 Main Street Akron, Ohio

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Carrier Engineering Corporation, New York.
Clarage Fan Co., Kalamazoo, Mich.
W. L. Fleischer Co., New York, N. Y.
Massachusetts Blower Co., Watertown, Mass.
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Simmons Co., John, New York.
AIR.
New York Blower Co., Chicago, Ill.

COOLERS.
OIL.
Griscom-Russell Co., New York.

CONDENSERS.
Alberger Heater Co., Buffalo, New York.
Alberger Pump & Condenser Co., New York.
American Radiator Co., Chicago, Ill.
American Steam Pump Co., Battle Creek, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Elliot Co., Jeanette, Pa.
Griscom-Russell Co., New York.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CONVERTERS, HOT WATER.
Patterson-Kelley Co., New York.
Whitlock Coil Pipe Co., Hartford, Conn.

COVERING, PIPE.
America District Steam Co., No. Tonawanda, N. Y.
Hornung, J. C., Chicago, Ill.
National Asbestos Mfg. Co., Jersey City, N. J.
Ric-Wil Co., Cleveland, O.
Wyckoff & Son Co., A., Elmira, N. Y.

DAMPERS, DUCT.
American Blower Co., Detroit, Mich.
Buckeye Blower Co., Columbus, O.

DEHUMIDIFYING APPARATUS.
Atmospheric Conditioning Corp., Phila., Pa.
Carrier Engineering Corporation, New York.
W. L. Fleisher Co., New York, N. Y.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

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Griscom-Russell Co., New York.

DRYING SYSTEMS.
(See Air Cooling and Drying Systems.)

DUST COLLECTING SYSTEMS.
American Blower Co., Detroit, Mich.
Buckeye Blower Co., Columbus, O.
Buffalo Forge Co., Buffalo, New York.
Clarage Fan Co., Kalamazoo, Mich.
Hersh Brothers Co., Allentown, Pa.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago, Ill.
Skinner Bros. Mfg. Co., St. Louis, Mo.
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Atmospheric Conditioning Corp., Phila., Pa.
Clarage Fan Co., Kalamazoo, Mich.
Hersh Brothers Co., Allentown, Pa.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

DUST DETERMINATORS.
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ECONOMIZERS, FUEL.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

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Hoffman Specialty Co., New York.

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Hartmann Co., Charles, Brooklyn, N. Y.

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The Brownell Co., Dayton, O.
Clarage Fan Co., Kalamazoo, Mich.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
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American Blower Co., Detroit, Mich.
Clarage Fan Co., Kalamazoo, Mich.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

EVAPORATORS.
BOILER FEED MAKE-UP.
Griscom-Russell Co., New York.

EXHAUST HEADS.
Burt Mfg. Co., Akron, O.
Illinois Engineering Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Patterson-Kelley, Co., New York.
Simmons, Co., John, New York.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Wright-Austin Co., Detroit, Mich.

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Alberger Heater Co., Buffalo, N. Y.
Alberger Pump & Condenser Co., New York.
American District Steam Co., No. Tonawanda, N. Y.
Crane Co., Chicago, Ill.
Griscom-Russell Co., New York.
Hornung, J. C., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
Ric-Wil Co., Cleveland, O.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Webster & Co., Warren, Camden, N. J.

FANS, EXHAUST.
American Blower Co., Detroit, Mich.
Autovent Fan & Blower Co., Chicago, Ill.
Bayley Mfg. Co., Milwaukee, Wis.
Buckeye Blower Co., Columbus, O.
Buffalo, Forge Co., Buffalo, N. Y.
Clarage Fan Co., Kalamazoo, Mich.
Garden City Fan Co., Chicago, Ill.
Hersh Bros. Co., Allentown, Pa.
Ilg Electric Ventilating Co., Chicago, Ill.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago, Ill.
Seymour, Jas. M., Newark, N. J.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
L. J. Wing Mfg. Co., New York.

FILTERS, (Aerating).
Griscom-Russell Co., New York.
FEED-WATER.
Elliott Co., Jeanette, Pa.
Griscom-Russell Co., New York.
Ross Heater & Mfg. Co., Buffalo, N. Y.

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American District Steam Co., No. Tonawanda, N. Y.
Crane Co., Chicago, Ill.
Grinnell Co., Inc., Providence, R. I.
Simmons Co., John, New York.

FLANGES.
American District Steam Co., No. Tonawanda, N. Y.
Crane Co., Chicago, Ill.
Jenkins Bros., N. Y.

FURNACES, WARM AIR.
Twin Fire Furnace Co., Chicago, Ill.

GASKETS, METALLIC.
Sarco Co., New York.

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Webster & Co., Warren, Camden, N. J.

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Jenkins Bros., New York.

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Atmospheric Conditioning Corp., Phila., Pa.
Cooling Tower, Inc., New York.
Sturtevant Co. B. F., Hyde Park, Boston, Mass.

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Honeywell Heatng Specialties Co., Wabash, Ind.

GOVERNORS, (pump).
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Davis Regulator Co., G. M., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
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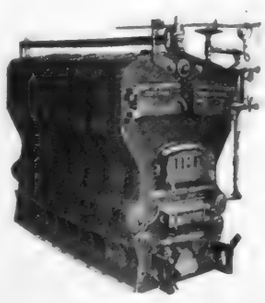

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Griscom-Russell Co., New York.
Hotstream Heater Co., Cleveland, Ohio.
Patterson-Kelley Co., New York.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Sims Co., Erie, Pa.
Whitlock Coil Pipe Co., Hartford, Conn.

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Griscom-Russell Co., New York.
McAlear Mfg. Co., Chicago, Ill.
Patterson-Kelley Co., New York.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Simmons Co., John, New York.
Sims Co., Erie, Pa.
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Sims Co., Erie, Pa.
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Massachusetts Blower Co., Watertown, Mass.
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Unit.

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H. W. Nelson Co., Moline, Ill.
Peerless Unit Ventilating Co., New York.

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Buckeye Blower Co., Columbus, O.
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Illinois Malleable Iron Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
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H. W. Nelson Co., Moline, Ill.
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Sterling Engineering Co., Milwaukee, Wis.
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Atmospheric Conditioning Corp., Phila., Pa.
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Douglass & Co., Thos. J., Chicago, Ill.
Grinnell Co., Inc., Providence, R. I.
W. L. Fleisher Co., New York, N. Y.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago, Ill.
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Sturtevant Co., B. F., Hyde Park, Boston, Mass.

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INSULATING MATERIALS.

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Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.

MECHANICAL DRAFT APPARATUS.

American Blower Co., Detroit, Mich.
Buckeye Blower Co., Columbus, O.
Clarage Fan Co., Kalamazoo, Mich.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
L. J. Wing Co., New York.

METERS.

Condensation.

American Dist. Steam Co., No. Tonawanda, N. Y.
Hornung, J. C., Chicago, Ill.

Feed Water.

Simmons Co., John, 110 Center St., New York.

Feed Water (Wier Type).

Webster & Co., Warren, Camden, N. J.

Pitot Tube.

American Blower Co., Detroit, Mich.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.

Steam.

American District Steam Co., No. Tonawanda, N. Y.
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American District Steam Co., No. Tonawanda, N. Y.
Wychoff & Sons Co., A., Elmira, N. Y.

PIPE HANGERS.

Grinnell Co., Inc., Providence, R. I.
Jenkins Bros., New York.
Simmons Co., John, New York.

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Crane Co., Chicago, Ill.
Grinnell Co., Inc., Providence, R. I.
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Crane Co., Chicago, Ill.
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McAlear Mfg. Co., Chicago, Ill.
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American Steam Pump Co., Battle Creek, Mich.
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Nash Engineering Co., So. Norwalk, Conn.
Skidmore Corp., Chicago, Ill.
Wright-Austin Co., Detroit, Mich.
Yeomans Bros., Chicago, Ill.
Young Pump Co., Michigan City, Ind.

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Alberger Pump & Condenser Co., New York.
American Steam Pump Co., Battle Creek, Mich.
Buffalo Steam Pump Co., Buffalo, N. Y.
Chicago Pump Co., Chicago, Ill.
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Nash Engineering Co., So. Norwalk, Conn.
Sprague Electric Works, New York.
Yeomans Bros. Co., Chicago, Ill.
Young Pump Co., Michigan City, Ind.

Condensation.

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Chicago Pump Co., Chicago, Ill.
Economy Pumping Machinery Co., Chicago, Ill.
Nash Engineering Co., So. Norwalk, Conn.
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Trane Co., La Crosse, Wis.
Western Engineering Co., Davenport, Iowa.
Wright-Austin Co., Detroit, Mich.
Yeomans Bros. Co., Chicago, Ill.

Rotary.

Nash Engineering Co., So. Norwalk, Conn.
Thompson Mfg. Co., Des Moines, Ia.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Steam.

American Steam Pump Co., Battle Creek, Mich.
Buffalo Steam Pump Co., Buffalo, N. Y.
Nash Engineering Co., So. Norwalk, Conn.

Turbine.

Alberger Pump & Condenser Co., New York.
Buffalo Steam Pump Co., Buffalo, N. Y.
Nash Engineering Co., So. Norwalk, Conn.
Yeomans Bros., Chicago, Ill.

Vacuum.

American Steam Pump Co., Battle Creek, Mich.
Bishop & Babcock Co., Cleveland, O.
Buffalo Steam Pump Co., Buffalo, N. Y.
Chicago Pump Co., Chicago, Ill.
Economy Pumping Machinery Co., Chicago, Ill.
Elliott Co., Jeanette, Pa.
McAlear Mfg. Co., Chicago, Ill.
Nash Engineering Co., So. Norwalk, Conn.
Skidmore Corp., Chicago, Ill.
Trane Co., La Crosse, Wis.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Yeomans Bros., Chicago, Ill.
Young Pump Co., Michigan City, Ind.

PYROMETERS.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

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American District Steam Co., No. Tonawanda, N. Y.
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Condensation.

Chicago Pump Co., Chicago, Ill.
Davis Regulator Co., G. M., Chicago, Ill.
Economy Pumping Machinery Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Yeomans Bros., Chicago, Ill.

REGULATORS.

Boiler-Feed.

McAlear Mfg. Co., Chicago, Ill.
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Wright-Austin Co., Detroit, Mich.

Damper.

American Dist. Steam Co., No. Tonawanda, N. Y.
Atlas Valve Co., Newark, N. J.
American Radiator Co., Chicago, Ill.
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McAlear Mfg. Co., Chicago, Ill.
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National Regulator Co., Chicago, Ill.
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Johnson Service Co., Milwaukee, Wis.
McAlear Mfg. Co., Chicago, Ill.
National Regulator Co., Chicago, Ill.
Powers Regulator Co., Chicago, Ill.
Sarco Co., New York.

SEPARATORS.

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Burt Mfg. Co., Akron, Ohio.
Elliott Co., Jeanette, Pa.
Griscom-Russell Co., New York.
Wright-Austin Co., Detroit, Mich.

STEAM.
American District Steam Co., No. Tonawanda, N. Y.
Bishop & Babcock Co., Cleveland, O.
Crane Co., Chicago, Ill.
Elliot C., Jeanette, Pa.
Griscom-Russell Co., New York.
Illinois Engineering Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Patterson-Kelley Co., New York.
Sims Co., Erie, Pa.
Webster & Co., Warren, Camden, N. J.
Wright-Austin Co., Detroit, Mich.

SHEET METAL CONSTRUCTION.
Hartmann Co., Charles, Brooklyn, N. Y.

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Massachusetts Blower Co., Watertown, Mass.
Seymour, Jas. M., Newark, N. J.

STRAINERS.

OIL
Burt Mfg. Co., Akron, Ohio.
Elliott Co., Jeanette, Pa.
Griscom-Russell Co., New York.

STEAM.
American Dist. Steam Co., No. Tonawanda, N. Y.
Elliott Co., Jeanette, Pa.
Illinois Engineering Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Wright-Austin Co., Detroit, Mich.

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(Recording and Indicating.)
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.
Standard Thermometer Co., Boston, Mass.

WATER.
Marsh & Co., Jas. P., Chicago, Ill.

THERMOSTATS.
American Radiator Co,. Chicago, Ill.
Atlas Valve Co., Newark, N. J.
Bishop & Babcock Co., Cleveland, O.
Johnson Service Co., Milwaukee, Wis.
Powers Regulator Co., Chicago, Ill.
Sarco Co., New York.

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Dole Valve Co., Chicago, Ill.
Dunham Co., C. A., Chicago, Ill.
Heating & Power Appliance Co. Milwaukee, Wis.
Hoffman Specialty Co., New York.
Illinois Engineering Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
Mouat-Squires Co., Cleveland, O.
H. W. Nelson Co., Moline, Ill.
O-E Specialty Co., Milwaukee, Wis.
Sarco Co., New York.
Sterling Engineering Co., Milwaukee, Wis.
Trane Co., La Crosse, Wis.
Webster & Co., Warren, Camden, N. J.

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Dunham Co., C. A., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
Jas. P. Marsh & Co., Chicago, Ill.
Mouat-Squires Co., Cleveland, O.
Simplex Heating Specialty Co., Inc., Lynchburg, Va.
Sterling Engineering Co., Milwaukee, Wis.
Trane Co., La Crosse, Wis.
Webster & Co., Warren, Camden, N. J.
Wright-Austin Co., Detroit, Mich.

STEAM.
American Blower Co., Detroit, Mich.
American District Steam Co., No. Tonawanda, N. Y.
American Steam Gauge & Valve Mfg. Co.
Crane Co., Chicago, Ill.
Davis Regulator Co., G. M., Chicago, Ill.
Dunham Co., C. A., Chicago, Ill.
Elliott Co., Jeanette, Pa.
Haines & Co., Wm. S., Philadelphia, Pa.
Hoffman Specialty Co., New York.
Illinois Engineering Co., Chicago, Ill.
Jenkins Bros., New York.
McAlear Mfg. Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
Patterson-Kelley Co., New York.
Sarco Co., New York.
Simmons Co., John, New York.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Trane Co., La Crosse Wis.
Wright-Austin Co., Detroit, Mich.

VACUUM.
American Blower Co., Detroit, Mich.
Bishop & Babcock Co., Cleveland, O.
Dunham Co., C. A., Chicago, Ill.
Heating & Power Appliance Co., Milwaukee, Wis.
Hoffman Specialty Co., New York.
Illinois Engineering Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Sarco Co., New York.
Sterling Engineering Co., Milwaukee, Wis.
Webster & Co., Warren, Camden, N. J.
Wright-Austin Co., Detroit, Mich.

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Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
L. J. Wing Mfg. Co., New York.

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Ric-Wil Co., Cleveland, O.
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American Radiator Co., Chicago, Ill.
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Jenkins Bros., New York.
Marsh & Co., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Hoffman Specialty Co., New York.
Simmons Co., John, New York.

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Sterling Engineering Co., Milwaukee, Wis.
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Illinois Engineering Co., Chicago, Ill.
Jenkins Bros., New York.
McAlear Mfg. Co., Chicago, Ill.
Simmons Co., John, New York.

BALANCED.
American District Steam Co., No. Tonawanda, N. Y.
Atlas Valve Co., Newark, N. J.
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Illinois Engineering Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.

BLOW-OFF.
Crane Co., Chicago, Ill.
Elliott Co., Jeanette, Pa.
Jenkins Bros., New York.
The Wm. Powell Co., Cincinnati, O.
Simmons Co., John, New York.

CHECK.
Crane Co., Chicago, Ill.
Jenkins Bros., New York.
Kennedy Valve Mfg Co., Elmira, N. Y.
The Wm. Powell Co., Cincinnati, O.
Simmons Co., John, New York.

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Crane Co., Chicago, Ill.
Dole Valve Co., Chicago, Ill.
Jenkins Bros., New York.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Marsh Valve Co., Erie, Pa.
The Wm. Powell Co., Cincinnati, O.
Simmons Co., John, New York.

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Dole Valve Co., Chicago, Ill.
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Kennedy Valve Mfg. Co., Elmira, N. Y.
Marsh Valve Co., Erie, Pa.
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NON-RETURN.
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Davis Regulator Co., G. M., Chicago, Ill.
Jenkins Bros., New York.
McAlear Mfg. Co., Chicago, Ill.
The Wm. Powell Co., Cincinnati, O.
Simmons Co., John, New York.

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Barnes & Jones, Boston, Mass.
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Capitol Brass Works, Detroit, Mich.
Commonwealth Brass Corporation, Detroit, Mich.
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Detroit Lubricator Co., Detroit, Mich.
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Dunham Co., C. A., Chicago, Ill.
Gorton & Lidgerwood Co., New York.
Heating & Power Appliance Co., Milwaukee, Wis.
Illinois Engineering Co., Chicago, Ill.
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Illinois Engineering Co., Chicago, Ill.
Jenkins Bros., New York.
Johnson Service Co., Milwaukee, Wis.
Kennedy Valve Mfg. Co., Elmira, N. Y.
McAlear Mfg. Co., Chicago, Ill.
Mason Regulator Co., Boston, Mass.
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Powers Regulator Co., Chicago, Ill.

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American District Steam Co., No. Tonawanda, N. Y.
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Hersh Bros. Co., Allentown, Pa.
New York Blower Co., Chicago, Ill.
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Massachusetts Blower Co., Watertown, Mass.

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Carrier Engineering Corporation, New York.
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Garden City Fan Co., Chicago, Ill.
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Massachusetts Blower Co., Watertown, Mass.
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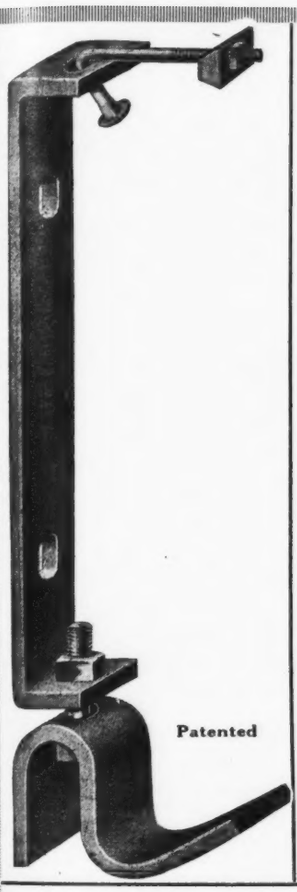

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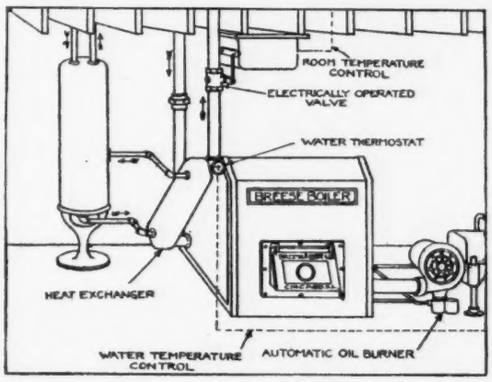

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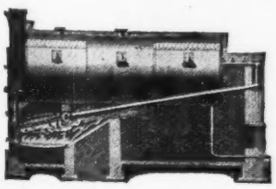

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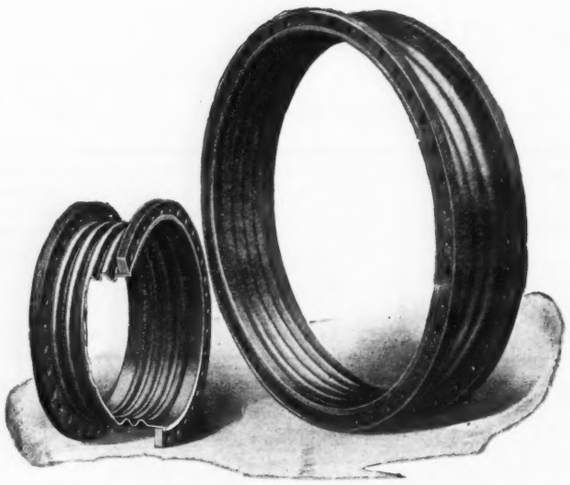

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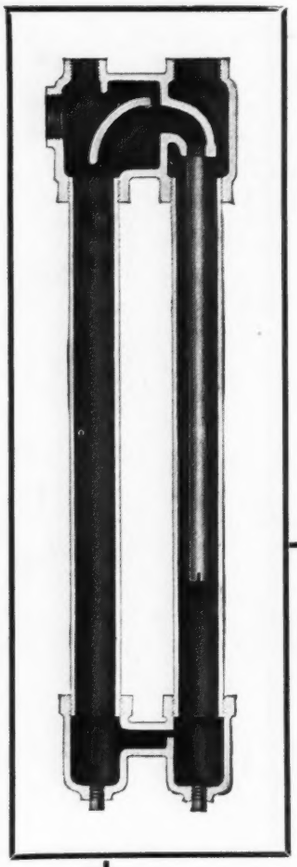

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